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"To the solid ground
Of Nature trusts the mind which builds for aye"—WORDSWORTH

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International Science

ONE of the most important developments of scientific activity during the latter half of the nineteenth century was the promotion of the exchange of scientific ideas between different countries by means of international associations Some of these were congresses which met at intervals of three or four years, when scientific communications were read and discussed, and, what was of still greater importance, an opportunity was afforded for those engaged in similar studies to make each other's acquaintance and understand each other's point of view Some associations were, on the other hand, more especially concerned to secure the co-operation of different nationalities in carrying out observations of particular natural occurrences on a uniform plan, or with standardised instruments, so that the results could be discussed as a whole and no portion of the field of work should be entirely neglected

The outbreak of War in 1914 caused an abrupt interruption to this friendly intercourse, which had up to that time exercised a very favourable influence in the progress of science On the occasion of previous hostilities, the conclusion of peace was always followed by a renewal of scientific *camaraderie*, but this did not occur after the last and most disastrous of wars The policy of the High Military Command of the Central European powers in waging war with a rigour previously unknown in modern times had imported unprecedented bitterness into the struggle, moreover, it must be remembered that, for the first time, scientific men themselves were brought into the conflict instead of continuing quietly to work in their laboratories, and maintaining correspondence with those of other nationalities, as was formerly the case It is not surprising, therefore, that when the War was over many scientific workers in the allied countries hesitated

to renew the relations that had previously existed, even though it seemed scarcely just to make their former scientific colleagues responsible for the conduct of their countries' military chiefs.

The subject was discussed at an Inter-allied Conference of men of science held in London in October 1918, about a month before the Armistice, and resolutions were passed. The most important, Article I., was in the following terms: "It is desirable that the nations at war with the Central Powers withdraw from the existing conventions relating to International Scientific Associations in accordance with the statutes or regulations of such Conventions respectively as soon as circumstances permit, and that new associations deemed to be useful for the progress of science and its applications be established without delay by the nations at war with the Central Powers, with the eventual co-operation of neutral nations."

A further conference was held at Paris towards the end of November 1918, when details were discussed and an executive committee appointed to prepare a scheme. As a result, an International Research Council was convened at Brussels in July of the succeeding year, and definite statutes of convention were adopted. In these the purposes of the International Research Council are declared to be (*inter alia*): (1) To co-ordinate international efforts in the different branches of science and its applications. (2) To initiate the formation of international Associations or Unions deemed to be useful to the progress of Science *in accordance with Article I. of the resolutions adopted at the Conference of London, October* 1918.

It is the incorporation of Article I. that determines the present character and policy of the International Research Council and the Unions formed under its auspices.

A list is given of the countries "that may participate in the formation of the International Research Council and of any Scientific Union connected with it, or join such Union at a subsequent period." It corresponds to the countries and dominions which were at war with the Central Powers, except that it includes Greece and Poland, and omits Russia and the new Baltic Powers. It then provides that, after a Union or Association is formed, "nations not included in the above list, but *fulfilling the conditions of Article I. of the resolutions adopted at the Conference of London*, and diplomatic Protectorates of the enumerated countries may be admitted either at their own request or on the proposal of one of the countries already belonging to the Union.

A favourable majority of not less than three-quarters of the countries already forming part of the Union shall be required for admission. The statutes of the Unions formed by the International Research Council require the approval of this Council."

Later, Czechoslovakia and a number of neutral countries, including Denmark, Norway, Holland, Sweden, and Switzerland, were invited to join the International Research Council and the scientific organisations attached to it.

As we have seen, the provision for the admittance of new countries refers only to the Unions, not to the Council itself, but it has in practice been assumed to apply to the Council. In an amendment to the constitution proposed by the Executive Committee this has been explicitly provided.

The meetings of the General Assembly are held, as a rule, once in three years. The last meeting was held in 1922, and the next will be on July 7 in the present year. At the meeting in 1922 it was resolved "that only countries which have adhered to the International Research Council are entitled to be members of the Unions connected with it."

The stringency of the exclusion of the men of science of former enemy countries is consistently maintained in the statutes of the Unions formed under the International Research Council. A rule which is, it is believed, common to them all provides that "the President of the Executive Committee [of the Union] may invite to a meeting of the General Assembly [of the Union] scientific men who are not delegates, *provided that they are subjects of one of the adhering countries*." It is at the General Assembly of a Union that scientific questions are considered, but no man of science, however eminent, is allowed to join in the discussion or even to be present if he belongs to one of the nations with which the Allies were formerly at war, and this after seven years of peace.

From the first there were many scientific men among the allied nations who objected to these stringent measures of exclusion, and as time passed their numbers have increased. Geology has not only refused to form a Union under the International Research Council, but, at the Congress in Brussels in 1922, adopted an independent constitution, without any provision for excluding subjects of the Central Powers, and a meeting will be held under it in Madrid in 1926. The International Mathematical Congress that was to have been held in the United States in 1924 was abandoned because in that country "neither scientific co-operation nor financial support were in sight for a congress under the rules of the International Research Council." A meeting was, however, held in Canada, when the American Section of the Union passed a resolution requesting the International Research Council to consider whether the time was not ripe for the removal of the restrictions on membership now imposed by the rules of the Council. The London Mathematical Society has

refrained from attending this meeting, as well as that preceding it at Strasbourg [1]

In view of the forthcoming meeting of the International Research Council, the Australian National Research Council has asked that this question shall be reconsidered The Royal Academies of Science of Holland, Denmark, and Sweden, and the Societe Helvetique have definitely purposed to amend the statutes by omitting all references to Article I of the Resolutions of the Conference of October 1918 This change would, it is presumed, permit any nation to be admitted to the International Research Council and the scientific organisation attached to it on a vote of a majority of not less than three-quarters of the countries already included Switzerland, however, would, by an additional provision, confine the privilege to countries forming part of the League of Nations

Holland and Denmark wish on the other hand, to rescind the provisions of the addition to the statutes in 1922, and thus permit a country to be admitted to a Union without previous admission to the Council The Executive Committee will not support this proposal, but suggests an amendment, providing that a country which has joined the International Research Council has the right to be admitted to the Unions connected with it

It is to be hoped that the International Research Council will not maintain the present exclusion of subjects of the former enemy powers, for we believe that this position is opposed to the wishes of the vast majority of the scientific men of the allied countries, and needless to say to the unanimous convictions of those of neutral lands

If the Swiss amendments are carried, no distinction will remain between allies, enemies, or neutrals The only condition of admittance will be membership of the League of Nations and the vote of the Council This would permit of the admission of Austria at once Germany would probably be eligible in a few months, but would have to wait for actual admission until the next General Assembly three years hence, unless of course she could be admitted conditionally on her joining the League of Nations Russia would presumably be excluded, as she is not likely to join the League

The simplest course would undoubtedly be to leave the question of admission to the uncontrolled discretion of the International Council, retaining, if it is thought desirable, the necessity of a three-quarters majority for a favourable decision We are hopeful that the General Assembly at Brussels next week will alter a situation which is both unsatisfactory and unreasonable

[1] Reference may also be made to the letter on this subject by Prof G H Hardy, president of the National Union of Scientific Workers, published in some leading daily newspapers on May 30, 1924

College Courses and University Examinations

A BOLD policy has been adopted by the Senate of the University of London with the view of solving one of the oldest and most difficult questions in relation to the organisation of University education in London—the question of establishing a close association between college courses of study and the examinations for university degrees The college selected for this experiment is the Imperial College at South Kensington, comprising the Royal College of Science, the Royal School of Mines, and the City and Guilds (Engineering) College Of these Colleges, the Royal College of Science has always adopted a distinctive method of training its students, based on the intensive study of one subject at a time The impracticability of completely adjusting the degree examinations of the University to this system of training, conjoined with a general desire on the part of the College for freedom in framing curricula, led to a prolonged and somewhat embittered controversy between the College and the University, in the course of which the College authorities adopted the extreme measure of applying for the status of a separate University This failed, as other attempts of the kind had previously failed but the fundamental problem remained unsolved

The history of the controversy as to relating University examinations to college teaching is as old as the University itself Established by Royal Charter in 1836 for the purpose of examining for academic degrees students of University College, King's College, and other affiliated colleges, the University in course of time adopted an attitude of aloofness to all colleges, though it was no part of the original conception of the University of London, as the Selborne Commission pointed out, that it should be a mere examining body, without any direct connexion with teaching institutions In those early days great importance was attached to the independence of the examining authority University College welcomed the Royal Charter for the University, on the ground that the professors of the College would not have to confer degrees on their own students There were, however, some connected with the College who raised the objection that the examinations would interfere with the independence of College teaching, both by determining the course of study and by affecting the method of instruction, and the College manifesto admitted that "this argument has weight" It is a tribute to the fairness and efficiency of the University examinations that this objection was not pressed for so many years In 1884 the "Association for Promoting a Teaching University for London" was formed This was the

first step leading to the reconstitution of the University of London as a teaching University The Senate and the Convocation—since shorn of some of its privileges—were not unfriendly to the general idea of a teaching University, and the Senate was even prepared to accept college examinations for pass degrees

It is of interest to note that the College to which the new scheme is to be applied is the College with which Huxley was connected as dean and professor, and that the policy adopted harmonises with his general views Huxley had a fine conception of the University which London ought to possess In his evidence given before the Gresham Commission in 1892—a model for soundness of judgment and clearness of expression—he severely condemned the attempt of University College and King's College to "corner" university education in London As an alternative to the creation of a separate teaching university, he urged that the title and prestige of the University of London should be retained, and the University reorganised in such a manner as to secure uniformity and efficiency in all university work, with freedom and elasticity "In short, unify without fettering" As to the conduct of university examinations, he urged the Commission to leave the question quite open Degree-giving was a subsidiary matter, not an end in itself While Huxley was in favour of trusting a college to organise and test the training of its students, he considered that some outside control was desirable, because every man has a "list," as they say at sea

The working of this experiment in relating college teaching to university examinations will be watched with interest, and its success may produce important results throughout the Empire in the direction of greater variety and elasticity in all our educational arrangements Let us hope, too, that it may tend to reduce the fervour of some of the worshippers of the examination-fetish The internal results should be not less valuable The Imperial College has not only closed a barren controversy, but also in the process has been selected for a position of special privilege in the University *Noblesse oblige* The University, faced with many other difficult problems, is entitled to the full co-operation of all its affiliated colleges Only last week the partial failure of the Bloomsbury site scheme was announced by the publication of some uninspired correspondence between the Treasury and the Principal Officer of the University This partial failure is due to the Government's arranging for the transfer of King's College to Bloomsbury without taking the elementary precaution of ascertaining whether this great College wished to move The problem of providing a home worthy of the University of the metropolis of the Empire still remains T LL H

Crop-Production in India

Crop-Production in India a Critical Survey of its Problems By A Howard Pp 200 (London Oxford University Press, 1924) 10s 6d net

IN recent years some of the lustre of what Disraeli in a flamboyant phrase described as "the brightest jewel of the British crown" has been dimmed by political happenings In the less spectacular sphere of economic improvement it might be said that new facets continue to be added to the jewel The most rabid of Swaraj fanatics must acknowledge that if British rule has accomplished nothing else it has at least, given their country material benefits in fullest measure Of these no better example can be found than the achievements of the small band of scientific workers who, during the last twenty years have been applying scientific methods to Indian agriculture

The most distinguished of these pioneers sets out the amazing story in the volume before us, and it is one calculated to excite the envy of his scientific colleagues all over the world He presents a record not only of scientific achievement, but also of an organisation under which the public support of science is not limited to the grudging provision of doles in aid of scientific research, for in India we see in operation a system of government under which the supreme power when satisfied that scientific work has been successful, straightway by administrative and legislative measures sets a seal on that work One example will suffice Mr Howard and his colleagues establish that an improved cotton (that is, a plant yielding a better fibre and more of it) cannot be effectively introduced unless steps are taken to prevent cross-fertilisation with inferior varieties, thereupon an Act is passed by the Legislature sanctioning the prohibition of the sowing (say in a district of 2000 square miles) of any variety of cotton other than that prescribed by expert plant breeders But it must not be thought that peaceful penetration is not practised also The poor *rayat* of India (whose life has been aptly described as "a long-drawn question between a crop and a crop") is as fully alive to the value of good seed as his fox-hunting cousin in the shires, witness such figures as these The area under Pusa 4 and Pusa 12 (two of Mr Howard's new wheats) in the United Provinces is now 500 000 acres, and in the North-West Frontier Province 200 000 acres In the Panjab colonies a new wheat known as Panjab 11 now occupies upwards of 750 000 acres The achievements of the workers on cotton improvement are equally striking In the Central Provinces the area under a new variety of this crop, introduced by the Agricultural Department, amounts to 700,000 acres, giving an additional profit to the cultivator of 20*s* per acre

In the case of rice (which in India occupies upwards of 80 million acres) some of the figures are equally astonishing, and the catalogue might be extended; many of the crops grown for fibre (such as jute) and for oil (such as linseed) have also yielded results to the scientific plant breeder.

The chief aim, however, of Mr. Howard's book is not to record economic results, many of which flowed from the application of scientific method rather than from original research. During the course of the work a number of problems requiring solution have been brought to light, and Mr. Howard has endeavoured to "set out these problems in simple language" with the view of securing the active co-operation of the public. (In other words, the days of paternal government are passing and the burden which is laid upon scientific workers in democratically governed countries is fast descending upon India.) The problems presented do not affect India alone. They affect the whole field of current knowledge regarding the soil and the plant. Workers in the sciences related to agriculture in all countries will find much food for thought in these pages.

The men who—as a result of Lord Curzon's enlightened policy—went out to India in 1904, found that their text-book knowledge was of little help; nor was Voelcker's classic report (*circa* 1890) of much assistance, for at that date the rôle of the leguminous plant in enriching the soil was unknown. Incidentally, it was familiar to the Indian *rayat*. The writer well remembers extracting, about that period, from a brown man in a loin-cloth a list of crops that enriched his soil—a catalogue, it proved, of some ten varieties of leguminous plants ranging from the shrub-like Cajanus to the weed-like Lathyrus.

Fortunately, this early period almost coincided with the birth of the Cambridge school of genetics, which, under the inspiration of Bateson and his disciples, has done so much to promote the economic welfare of agriculture. No better field than India for the exploitation of such master ideas as those of the "unit character and pure line" could have been found, and of these two tools (in contradistinction to what was experienced in more advanced countries) the latter—the pure line conception—has proved the more useful. As Howard, however, so aptly points out, economic plants fall into two very distinct categories from the point of view of the practical outcome of scientific plant breeding. The isolation and economic introduction of pure lines of plants which are normally self-fertilised—such as practically all the cereals—offers no difficulty; the production of a sufficiently diverse F_2 is the only problem. In the case of normally cross-fertilised plants, however, such as cotton (or the Brassicæ), the practical obstacles are serious. As indicated above, this problem has been partly solved in India by drastic legislation of a type to which the free-born Western would probably never submit. If to free cross-fertilisation self-sterility be added (the clover is an example), the problem of seed production, both scientifically and practically, becomes one of extreme difficulty. As our author points out, "the creation of an improved variety of crop, by itself, is of no practical advantage to the country; it possesses only a potential value. The new variety must be welded into the rural economy before a real economic result can be achieved." It is perhaps one of the most striking features of the Indian achievements that the plant breeders there have studied intensively and successfully this problem of adapting their improvements to rural economics.

To return to the agricultural problems which confront the scientific workers in India: of these the most puzzling, perhaps, is provided by rice, an aquatic plant with no obvious access to added nitrogen. The produce of 10 million acres of this crop has been exported from Burma annually for the last twenty years, and yet the soil shows no signs of diminishing fertility. The problematic source of nitrogen may be fixation by the algæ which inhabit the swamps in which rice is grown. Then, as to the source of the oxygen needed by the roots of the plant, we seem to be equally in the dark. Other problems which have arisen may be briefly indicated. The relation between the economic behaviour of crops and their root development is still obscure. Many facts can be instanced to show that a close relation exists between the quality of a crop and the root development of the plant in varying soils; and an equally important connexion appears to exist between root development and susceptibility to disease. The author believes that attacks of disease in economic plants simply indicate faulty cultural methods, a view that seems to find a parallel in some modern ideas as to disease in the human subject. He is identified with extreme views on the importance of soil aeration, but there can be no question that he presents a body of facts which strongly supports his theories on the subject. The whole question of the "gearing" (as he terms it) between the plant and the soil stands in need of thorough investigation in the light of newer knowledge.

The work of Howard, and, may we add, of his equally distinguished wife, may be taken as a model of what is required of research workers in the applied sciences—the practice of pure scientific research coupled with the rare faculty of a steadfast outlook towards the ultimate economic application of the results. These are qualities which should prove of great value in the direction of the all-India cotton research station to which the author has recently been appointed.

A. B. B.

The Literature of Chemical Technology

Synthetic Organic Compounds By Dr S P Schotz Pp 412 (London Ernest Benn, Ltd, 1925) 45*s* net

SEVERAL books have appeared during the past year or so, both in Great Britain and in the United States, which deal with certain special branches of chemistry from the industrial and manufacturing points of view Without doubt many of these treatises are excellent and constitute well-written and concise accounts of particular types of manufacture They may be regarded, therefore, as valuable contributions to technological literature, and are comparable in this respect with similar treatises written by experts in one or other of the many sections of scientific chemistry In each case the author may be supposed to have, not only a far-reaching knowledge of his subject, but also to possess sufficient wisdom, as distinct from knowledge, to enable him to sift the grain from the chaff in the published literature of the subject with which he deals Nevertheless, even in a clear-cut comparison such as this, the difficulties met with by the two types of author are very different

The writer of the scientific treatise finds to hand a vast amount of published detail from which to draw his material Moreover, he can assume, with a reasonable amount of confidence, that the sources on which he relies constitute accurate and truthful records of the experimental work done and the conclusions reached The fact that they have been issued under the auspices of one or other of the world's scientific societies gives him the right to assume that they have been published without reserve or ulterior motive

On the other hand, the writer of the technological book, as soon as he passes away from matters of personal knowledge, finds himself beset by many troubles which will require the greatest powers of discrimination to overcome For example, he will have to draw largely on the patent literature, and chemical patent literature, especially that of certain foreign countries, is in some instances a compilation of experimental data, and conclusions deduced therefrom, often emanating from the imaginations of those patentees who wish to retain some special field for the exercise of their own activities, or who may wish to mislead their competitors He will also have to use the chemical technological literature published in one or other of the various journals devoted to this subject, and, here again, he will encounter difficulties This type of literature is on the increase, and already there are many publications catering for the requirements of the works chemist and chemical engineer In them the letterpress and the illustrations often serve as convenient vehicles for the advertisements which form the major portions of the periodicals The illustrations and the advertisements are mostly those of plant, and this is a useful feature for those who wish to keep themselves in touch with the development of engineering chemistry The letterpress is, however, frequently of the chatty and personal kind, and only a portion of it is devoted to articles and papers on manufacturing processes and reactions But, in the very nature of things, it is obvious that such contributions can only be written by authors from the outside, because it is unthinkable that any sane manufacturer or employee of a manufacturer, would be prepared to publish details of plant and processes very rightly regarded as essential to his works practice and prosperity

Finally, there are the secret matters, researches carried out by the governments of States in the national interest, usually for war purposes both offensive and defensive It is here that the angels fear to tread and where discrimination will counsel avoidance The difficulties in these cases embrace both the types mentioned above, since publication implies either that the data is useless or out-of-date, or that the information is supplied with the direct object of creating a false impression and of misleading a possible enemy It is evident that no State, however altruistic in outward appearance, would allow any matter of real importance in relation to its war activities to be published, and any chemist doing such a thing from sure knowledge would in Great Britain, soon fall foul of the Official Secrets Act

It is therefore clear that the way of the author of the technological book is, indeed, hard, even when he confines himself to some particular branch of his subject with which he has special acquaintance What then is to be said of a book, such as that under review, which purports to cover the wide field of synthetic organic chemistry, a field with which no human being could possibly have intimate personal knowledge even on the scientific side alone?

It is not suggested that the author has not attempted to carry out his Herculean task with courage and ability The book has entailed the exercise of great industry and skill in its compilation and it is evident that the author possesses a wide knowledge of the many intricate subjects with which he deals It is readable and the printing and paper leave nothing to be desired It contains a great deal of information which will be useful to the general reader, although some of the statements made may anger the expert One general criticism that could be raised is that the formulæ are too elaborate and the frequent use of the benzene ring wholly unnecessary It is, for example, a shocking waste of the excellent paper to print the formulæ of the phenol-formaldehyde resins on pp 384, 386, and 387 These formulæ are not based on any single shred

of scientific evidence, and are, indeed, in the highest degree unlikely The illustrations of plant are admirable, and will serve as excellent advertisements for the firms supplying them Indeed it is evident that they are intended as such, because the "Bakeliser" (Fig 109, p 372) is also reproduced in the advertisement pages at the end of the book, and when this is not the case the name of the firm supplying the apparatus appears under the illustration The plants of the various processes described are also reproduced clearly

The reviewer has, therefore, no quarrel with the author, but, on the contrary, congratulates him on having accomplished a very difficult task with commendable ability It is rather the object and utility of the book that he calls in question As a scientific treatise it is of little value, and as a technological handbook it is in many respects misleading The statements made, for example, in the article on chemical warfare will bring a smile to the lips of those who have inside knowledge of this subject

With what, then, are we dealing, and to what kind of reader is the book likely to appeal? It is, as already stated, readable and will doubtless interest a number of people who take their chemistry lightly and superficially, but, if this were intended, it is surely unnecessary to have included the complex descriptions of intricate organic reactions which only the expert can follow It may be intended to appeal to manufacturers and to chemists engaged in industrial work, and here again material will be found which will be of interest and general utility, although, if the chemist happens to meet a description of any method of which he has special knowledge, he is not likely to place much reliance on the accounts of other processes In effect, therefore, the book will appeal to a number of various types of people who may wish to acquire a superficial and incomplete knowledge of many of the operations now carried out in modern organic chemical manufacture and are not in a position to be hypercritical of the information they receive Doubtless there are several of these, since this is only one of the many books of its kind which have been published and, we understand, are about to be published, and it is only reasonable to suppose that their production pays

Moreover, there can be no question that books of this kind serve a useful purpose in popularising science, and in bringing home to many people the achievements which the modern development of scientific industrial methods have accomplished in supplying them with some of the present-day requirements of life The only doubt in the present instance is whether the author has supplied sufficient jam to mask his very large pill and to make it palatable to the general reader

J F T

The Electrical Theory of Matter

Handbuch der Radiologie Herausgegeben von Prof Dr Erich Marx Band 6 Die Theorien der Radiologie Bearbeitet von M Laue, P Zeeman, H A Lorentz, A Sommerfeld und G Wentzel, Georg Joos, E Riecke, L Vegard, P Debye Pp xi+806 (Leipzig Akademische Verlagsgesellschaft m b H, 1925) 40 gold marks

THERE exists scarcely any branch of science which is not indebted to Germany, not only for important original contributions to its progress, but also for the publication of excellent and comprehensive treatises With the appearance of this sixth volume, another of these so-called handbooks reaches completion It is now some years since the last of the previous volumes was published, and it is evident, from the remarks made by the general editor, Dr Marx, that this volume has only reached completion after much delay and the surmounting of many difficulties That this should be so is scarcely surprising From the theoretical point of view, modern physics is in a peculiar position The two rival theories—the older classical theory and the more modern quantum hypothesis—have each met with marked success in interpreting observed results, but we are still very much in the dark as to the real connexion between the two Where one fails the other as often as not succeeds We must therefore be prepared, in such a volume as this, to find, not so much a logical development, but rather a series of attempts at correlating observed phenomena in terms of one or other of the two main lines of thought, and this indeed we actually find

To do justice in small space to a volume of this magnitude, dealing with mathematical theory and coming from the pens of seven separate authors, is clearly impossible Fortunately, with such names as Lorentz, Laue, Sommerfeld, Debye, and others on the title-page, there is little room for doubt as to the quality of the contents From such authors we know what to expect, and a closer inspection does not disappoint us The previous volumes dealt essentially with the more experimental side of modern physics, and it was intended to devote the final volume to a discussion of its purely theoretical aspect While this plan has been to a large extent adhered to, the reader will find a pleasant variation in the few chapters which deal with experimental results in fields which have not been covered in the previous volumes Notable in this connexion are the excellent account of the Zeeman effect and Dr Joos's summary of the results of work on ionisation potentials

The volume opens with a discussion of the motion of a free electron in various types of electric and magnetic

fields, after a very full treatment of this question, Prof von Laue proceeds to consider the problems of conduction through gases and the passage of α and β particles through matter The discussion of the motion of the free electron is naturally followed by an account of the motions of electrons in the atomic field and of the way in which these may be influenced by external forces A most lucid description of the magnetic separation of spectral lines comes, as is only fitting, from Prof Zeeman, whose name the phenomenon bears That the theory of the effect should be contributed by Prof Lorentz is also most appropriate, since it was he who first put forward a quantitative explanation of the influence of a magnetic field on the spectrum The abandonment of the original theory based on the classical mechanics in favour of one founded on the quantum hypothesis is an example of what has taken place in many branches of physics A general account of the origin of optical spectra on the basis of the Bohr atom is developed by Prof Sommerfeld and Dr Wentzel Prof Sommerfeld's work on this subject is so well known and so widely appreciated that there is no need to dwell on the merits of this section The summary by Dr Joos, dealing with ionisation potentials and the conditions for the excitation of spectra, forms a suitable conclusion to the treatment of atomic radiation

A long and detailed account of the electrical theory of the solid state, dealing notably with such problems as electric and thermal conductivity, was contributed by the late Prof Riecke As a considerable period has elapsed since this section was written, it has been copiously annotated by Prof Laue in order to bring what is a very thorough discussion up-to-date

One of the most readable sections is that on the aurora by Prof Vegard It is a subject that the author has made peculiarly his own, and his description of the observed facts and the theory are full of points of interest Some of his conclusions have recently been questioned, especially his explanation of the source of the famous green line, but whether or not his theory will require modification, it has already achieved one of the main objects of any theory in suggesting a new field of research in the study of the spectra emitted by matter at extremely low temperatures when bombarded by electrons

The final chapters, written by Prof Debye, are devoted to the theory of the electrical and magnetic properties of molecules The subject is one of great complexity, and it is impossible not to admire the way in which it has been treated The subject of magnetism has perhaps scarcely kept pace with the progress which has been made of recent years in other branches of physics, but signs are not wanting that the near future will see a rapid development Prof Debye's account, written in his extremely lucid style, indicates some of the lines along which we may expect progress

The editor and his collaborators are to be congratulated on the completion of the "Handbook of Radiology" This final volume will prove invaluable to all students of modern physical theory, inasmuch as it gives full discussions, with extensive references to original papers, of a wide range of subjects, many of which have not so far received adequate treatment in text-book form The book is full of indications of probable lines of advance, and in this respect will make an appeal not only to the theorist but also to the experimental worker

Digitalis in Medicine

The Action and Uses in Medicine of Digitalis and its Allies By Prof Arthur R Cushny Pp xi+303 (London Longmans, Green and Co, 1925) 18*s* net

OUR knowledge of the action of digitalis on the heart was founded by William Withering, of Birmingham, whose classical treatise was published in 1785 Since that time, owing to the multiplicity and scope of the researches of an ever-increasing number of workers, the literature of the subject has reached such proportions that an attempt to collect together and analyse the results achieved appears already overdue Prof Cushny has undertaken this arduous task in compiling the monograph under notice, in which the knowledge acquired during thirty years of personal research is embodied in a critical account of the whole subject, from the time when digitalis was first employed in heart disease up to the present day

The book opens with an account of the various drugs of the digitalis group and their histories It is not certain when digitalis first came into medical use but it was known long before Withering's time, and the English term "foxglove" may bear some allusion to Fuchsius of Tubingen, who described it in 1542 as an emmenagogue Apart from digitalis, many of these drugs were originally employed as arrow poisons, and for the purpose of trial by ordeal, by the natives of Africa and the Malayan Archipelago A detailed account is given of the action of digitalis on the frog's heart, illustrated by numerous graphic records of the heart movements The reaction of the mammalian heart to digitalis, as seen in animal experiment is similarly dealt with Some conception of the scope of the laboratory investigation is gained when we are told that the effect of digitalis or allied drugs on the heart is known in the cases of the frog, toad, grass snake, green lizard, rat, tortoise, crab, crayfish, lobster, snail, newt, tadpole and embryonic chick, among others

Pigeons are relatively susceptible to the drug, rats and toads tolerant, while man is more susceptible, weight for weight, than animals

In Chapter vi the author discusses at length the action of digitalis on the blood pressure Blake's discovery in 1839 that a rise in arterial tension was produced in animals by large doses of digitalis gave rise to a controversy over its action in man which has persisted almost up to the present day, although Sahli showed in 1901 that this result did not follow therapeutic doses Prof Cushny holds it proved that this rise in blood pressure seen in animals is due mainly to constriction of the vessels, but he emphasises the fact that there is no evidence of a similar effect being brought about in man by medicinal doses of the drug No doctrine has died harder among medical men than the belief that digitalis is dangerous in cases of high blood pressure, but it is to be hoped that this has now been finally banished from medical teaching

After a description of the effects of digitalis on organs other than the heart, its absorption, elimination, and cumulative action, seventy pages are devoted to therapeutics Withering's knowledge of digitalis was the outcome of ten years' clinical observation in his practice, and although his work was followed by such a vast amount of research in animals, no real advance in the clinical use of the drug can be said to have occurred until more than a century later, when Sir James Mackenzie discovered its almost specific action in cases of auricular fibrillation, again as the result of clinical observation In the case of abnormal heart rhythms the mechanism of the action of digitalis is now well understood, but we are still unable to account for its variable and uncertain effect in cases of normal rhythm On this obscurity Prof Cushny is unable to throw any new light, but we gather that he regards the direct action on the heart muscle, increasing the force of the contraction, as a more important factor than the reduction in rate in bringing about the undoubted clinical improvement which sometimes follows digitalis administration in these cases At present this cannot be accepted as proved, and it is here that future researches may be expected to add to our knowledge In pneumonia the author believes that digitalis can effect the heart beneficially, but he is unable to arrive at any definite indications for giving the drug, and does not advise its routine use in this disease

The effect of digitalis on the electro-cardiogram is described, and we are somewhat surprised to find that Prof Cushny attaches so little significance to the flattening and inversion of the T-wave which is such a constant effect of adequate doses of the drug in practice The book concludes with a description of the various preparations of digitalis and the methods used in their assay A bibliography of 559 references to the literature is placed at the end of the book

A treatise of this nature, covering the ground of both laboratory research and clinical practice, and coming from such an authority as Prof Cushny, who has himself played no small part in the development of the subject, is an invaluable addition to the literature of digitalis Moreover, the book affords the reader ample opportunity for studying the relationship of animal experiment to practical medicine The fact that the reaction of healthy animals to poisonous doses of a drug may differ widely from the effects of medicinal doses on diseased mankind has not always been sufficiently appreciated in the past, mainly perhaps owing to the tendency of the laboratory worker to become too isolated from the clinician The advantages of close co-operation between laboratory and clinic are nowhere better illustrated than in this admirable account of the work which has transformed digitalis, once an old country remedy for dropsy, into what may be justly described as one of the best-mapped regions of therapeutics

Our Bookshelf.

Monographs of the Geological Department of the Hunterian Museum, Glasgow University 1 *The Collection of Fossils and Rocks from Somaliland* Made by B K N Wyllie and Dr W R Smellie Pp vi+180+18 plates (Glasgow Jackson, Wylie and Co, 1925) 42*s* net

THIS work deals mainly with the palæontology of the Jurassic, Eocene, and Oligocene deposits of part of the maritime plain of British Somaliland in the neighbourhood of Bulhar and Berbera (Gulf of Aden), and is based on the collections made by Messrs Wyllie and Smellie when surveying the region on behalf of the Anglo-Persian Oil Company It is to be hoped that other companies will adopt this policy of allowing matter of geological interest to be published The collection has been presented to the Glasgow University Museum

A summary of the geology of the district is given by B K N Wyllie, based on the joint work of himself and Dr Smellie, but petroleum is not mentioned The palæontology is the work of R B Newton (Foraminifera and Nautilus), J W Gregory (Corals), E D Currie (Echinoidea), J Weir (Brachiopoda and Mollusca), and L F Spath (Ammonites) A short account of the igneous rocks is given by A T Neilson

The Jurassic deposits consist of (1) a lower series, the Bihin Limestone, 1000 feet thick, of which the age is not precisely determined but appears to range from Bathonian to Oxfordian The corals and echinoids are unlike those of Cutch but have affinities with European faunas of similar age, from which it is inferred that the Somaliland sea had no direct connexion with that of western India but must have been a gulf from the Mediterranean (2) The upper series, known as the Meragalleh limestone, 2300 feet in thickness, is shown

by the ammonites to be mainly Kimeridgian but possibly extending into Tithonian and Infravalanginian The differences between the ammonite faunas of Somaliland and other regions are regarded by Spath as due to differences of age rather than to difference of facies or geographical province

The beds of Eocene age consist of limestones and sandstones containing corals, echinoids, lamellibranchs, Nautilus, etc At about the middle some 2000 feet of gypsum and anhydrite occur, indicating that part of the sea became isolated and underwent intense evaporation The Oligocene limestone is regarded as of Aquitanian age and contains calcareous algæ, foraminifera, corals, etc The corals resemble those of the Tongrian of northern Italy, Austria, and the West Indies The absence of Miocene and Pliocene deposits suggests that the Gulf of Aden was not covered by sea until the end of Pliocene times, a little earlier than the date of the raised coral reefs

It is unfortunate that in many cases the figures of the fossils are unsatisfactory Some of the specimens were evidently unsuitable for illustration by photographic means and their characteristics cannot be made out

Researches on Fungi By Dr A H Reginald Buller Vol 3 The Production and Liberation of Spores in Hymenomycetes and Uredineæ Pp xii+611 (London Longmans, Green and Co, 1924) 30*s* net

It is a pleasure to welcome the third volume of Dr Buller's researches into the production and liberation of spores in the fungi, the second volume of which was noticed in NATURE of October 27, 1923, p 614 The delicacy of technique, the minuteness and exactness of the observations, and the assiduousness in the elucidation of abstruse details so characteristic of the first two volumes are well maintained in the present work

In Part I the author continues his observations on the mechanisms of spore dispersal in the Agaricineæ He distinguishes two main types of organisation for the production and liberation of spores (1) Æquihymeniferæ, with thick wedge-shaped gills, not afterwards destroyed by autodigestion, and (2) Inæquihymeniferæ, with thin parallel-sided gills, afterwards autodigested from below upwards In the first five chapters the fruit mechanisms of sub-types of the first group are described, *e g* Lepiota, Bolbitius, Armillaria Most of the remainder of Part I deals with sub-types of the second group, as exemplified by species of Coprinus Some interesting material on the bilumenescence of Panus, and the parasitism of Agarics on Agaric hosts, is also introduced Part II of the volume takes up the production and liberation of basidiospores in the Uredineæ Dr Buller finds the essentials of spore dispersal similar to those of the Hymenomycetes In this case, however, the spores are larger and are shot to a greater distance Some teleological but none the less interesting correlations are given regarding the curvature of the basidium in Uredineæ, and the straight form found in most Hymenomycetes As in the first two volumes, the book is profusely illustrated with interesting photographs and many of the author's fine drawings J E

Offa's Dyke By J H Hewlett Pp 32+8 plates (London Simpkin, Marshall and Co, Ltd, n d) 3*s* 6*d* net

For some time past it has been evident that public interest in archæological discovery has been on the increase, and that this interest has extended to sites of historic and prehistoric importance is to some extent borne out by the protests aroused some two years ago by the threat to interfere with the amenities of Stonehenge Mr Hewlett's description of Offa's Dyke is a book which is welcome on this account The more well-informed the public is about the antiquities of the countryside, the better chance of the avoidance of wanton damage Mr Hewlett has divided his account of this interesting defensive work into five sections In the first, he gives a general description of the dyke, in the second, he traces its course and offers suggestions as to its line where it has now disappeared in the third, he describes the country through which it passes, in part four he discusses the theories of its purpose, and in the fifth, gives the main facts connected with the life of Ossa As to its original place of termination in Flintshire, which is still a problem, Mr Hewlett states the theories which have been put forward, but himself has no solution to offer, although he is of the opinion that it is Wat's Dyke and not Offa's Dyke which ends at Basingwirke, notwithstanding the occurrence along this line of place-names such as Plas Offa Bryn Offa, and Clawdd Offa (Offa Dyke)

Handbuch der Pflanzenanatomie Herausgegeben von Prof K Linsbauer Abteilung 2, Teil 2 Bryophyten Band VII/1 Anatomie der Lebermoose Von Prof Dr Th Herzog Pp iv+112 (Berlin Gebruder Borntraeger, 1925) 8 70 gold marks

Dr Th Herzog has produced a monograph of 108 pages with ninety-three text figures upon the anatomy of the liverworts, and in this space it would appear possible to give a very complete report of progress in this very specialised field There is however, no mention of mycorhiza, and some important American work is not discussed The work is divided into three sections In the first there is a description of the various types of differentiated cell reported in the group, and it is striking how frequently these differentiated elements are to be found in thalloid forms This section is followed by two further sections dealing with the anatomy of gametophyte and sporophyte respectively, in which each group of the liverworts is passed in review in turn

Introduction to Modern Political Theory By C E M Joad (The World's Manuals) Pp 127 (Oxford Clarendon Press, London Oxford University Press, 1924) 2*s* 6*d* net

This short manual gives an excellent and clear account of the various socialistic and communistic theories which have recently become important owing to the success of the revolutionary movement in Russia Mr Joad takes naturally to this kind of work and is peculiarly well fitted for it He can write sympathetically without the loss of balance which spoils the work of the propagandist

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE *No notice is taken of anonymous communications*]

The Taungs Skull

THE account which Prof Dart published of the Taungs skull (NATURE, Feb 7, p 195) left many of us in doubt as to the true status of the animal of which it had formed part, and we preferred, before coming to a decision, to await an examination of the fossil remains, or failing such an opportunity, to study exact casts of them For some reason, which has not been made clear, students of fossil man have not been given an opportunity of purchasing these casts, if they wish to study them they must visit Wembley and peer at them in a glass case which has been given a place in the South African pavilion

The chief point which awaited decision relates to the position which must be assigned in the animal kingdom to this newly discovered form of primate Prof Dart in writing of it, has used the name of anthropoid ape, he has described it as representing ' an extinct race of apes intermediate between living anthropoids and man —which is tantamount to saying that at Taungs there has been discovered the form of being usually spoken of as the " missing link " That this is his real decision is evident from the fact that he speaks of it as ' ultrasimian and prehuman and proposes the creation of a new family for its reception

An examination of the casts exhibited at Wembley will satisfy zoologists that this claim is preposterous The skull is that of a young anthropoid ape—one which was in the fourth year of growth—a child—and showing so many points of affinity with the two living African anthropoids—the gorilla and chimpanzee—that there cannot be a moment's hesitation in placing the fossil form in this living group At the most it represents a genus in the Gorilla-Chimpanzee group It is true that it shows in the development of its jaws and face a refinement which is not met with in young gorillas and chimpanzees at a corresponding age In these respects it does show human-like traits It is true that it is markedly narrow-headed while the other African anthropoids are broad-headed—but we find the same kind of difference in human beings of closely allied races Prof Dart claimed that the brain showed certain definite human traits This depends upon whether or not he had correctly identified the position of a certain fissure of the brain—the parallel fissure In the show-case at Wembley a drawing is placed side by side with the ' brain cast ", but when we examine the brain cast at the site where the fissure is shown on the drawing we find only a broken surface where identification becomes a matter of guess-work

In every essential respect the Taungs skull is that of a young anthropoid ape possessing a brain which, in point of size, is actually smaller than that of a gorilla of a corresponding age Only in the lesser development of teeth, jaws, and bony structures connected with mastication can it claim a greater degree of humanity than the gorilla Its first permanent molar teeth which have just cut are only slightly smaller than those of the gorilla, while the preparations which are being made in the face for the upper permanent canines show that these teeth were to be of the large anthropoid kind

The other point on which we awaited information related to the geological age of the Taungs skull Fortunately, Dr Robert Broom (NATURE, April 18 p 569) has thrown a welcome light on this matter The skull was blasted out of a cave which had become filled up by sand washed in from the Kalahari The fossil baboons found in neighbouring caves differ in only minor structural details from baboons still living in South Africa In Dr Broom's opinion the Taungs skull is of recent geological date, it is not older than the Pleistocene, he thinks it probable that it may not be older than the fossil human skull found in a limestone cave at Broken Hills, Rhodesia It is quite possible—nay, even probable—that the Taungs anthropoid and Rhodesian man were contemporaries Students of man s evolution have sufficient evidence to justify them in supposing that the phylum of man had separated from that of anthropoid apes early in the Miocene period The Taungs ape is much too late in the scale of time to have any place in man's ancestry

In a large diagram, placed in the show-case at Wembley, Prof Dart gives his final conception of the place occupied by the Taungs ape in the scale of man's evolution He makes it the foundation stone of the human family tree From the " African Ape Ancestors, typified by the Taungs Infant, Pithecanthropus, Piltdown man, Rhodesian man, and African races radiate off A genealogist would make an identical mistake were he to claim a modern Sussex peasant as the ancestor of William the Conqueror

In the show-case at Wembley plastic reconstructions are exhibited in order that visitors may form some conception of what the young Taungs Ape looked like in life Although the skull is anthropoid it has been marked by a ' make up ' into which there have been incorporated many human characters It is true the ears are those of the chimpanzee but the forehead is smooth and rounded the hair of the scalp is sleek and parted, the bushy eyebrows are those of a man at fifty-five or sixty, the neck is fat thick, and full — extending from chin to occiput In modelling the nose gorilla lines have been followed whereas the nasal part of the skull imitates closely chimpanzee characters The mouth is wide, with a smile at each corner

Prof Dart has made a discovery of great importance and the last thing I want to do is to detract from it He has shown that anthropoid apes had extended, during the Pleistocene period, right into South Africa—into a land where anthropoid apes could not gain a livelihood to-day He has found an extinct relative of the chimpanzee and gorilla but one with more man-like features than are possessed by either of these His discovery throws light on the history of anthropoid apes but not on that of man Java-man (Pithecanthropus) still remains the only known link between man and ape and this extinct type lies on the human side of the gap

ARTHUR KEITH

June 22

Spectroscopic Evidence of *J*-Transformation of X-rays

IN a recent letter to NATURE (April 25) Messrs Khastgir and Watson have given some graphical tables where the wave-lengths of the X-ray line K are plotted against the atomic number of the elements Nos 48-60 In these curves there are two discontinuities at Z 52 and at Z 56, which the authors ascribe to the supposed J-transformation of Barkla The authors state as follows (p 605) " This seems to be the first spectroscopic evidence of the J-transformation "

The curves are said to represent the results of my measurements of the K wave-lengths Several of the values, however, are *not* those found in my laboratory, but seem to be taken from different, and not very concordant, measurements For example, the element Cs (55) had never been published in any paper from my laboratory at the time when the letter by Messrs Khastgir and Watson was written

The K-series of the elements in question had been measured in my laboratory once by Dr Malmer in the earliest days of X-ray spectroscopy (1914–15) His measurements give no evidence of such a sudden change in the slope of the curve as shown in the letter of Messrs Khastgir and Watson As these values were obtained with a simple, and not very accurate, method, there are accidental errors of the magnitude 0 005 Å U In the *Phil Mag* for

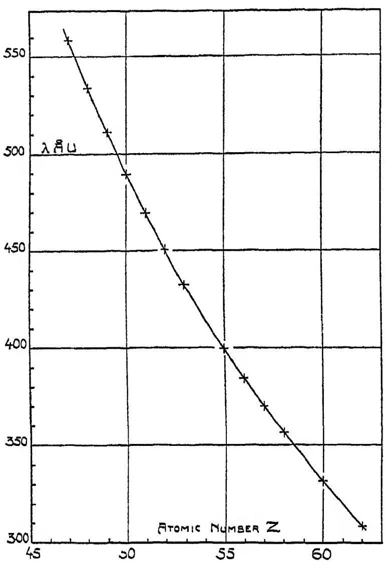

Fig 1

November 1919, Dr Leide and the author described a new method and an instrument by which more accurate measurements could be obtained in this region of wave-lengths Dr Leide, who has been working with this apparatus, has just published the results in his dissertation (Lund Gleerup, and some previous results of his investigation were given in my book, "X-ray Spectroscopy") His values which ought to be about 100 times as accurate as those mentioned above are as follows

Z	$K\alpha_1$ λ Å U	Z	$K\alpha_1$ λ Å U
47	0 55821	55	0 39959
48	53386	56	38445
49	51103	57	37004
50	48948	58	35647
51	46931	59	
52	45037	60	33125
53	43249	61	
54		62	30833

In the diagram the wave-lengths are plotted against the atomic number Z

No trace of such discontinuities as described by Messrs Khastgir and Watson is to be seen

Manne Siegbahn

Physical Laboratory, University, Upsala,
May 30

In a recent number of Nature (April 25, pp 604-605) there is a letter by Khastgir and Watson describing what is apparently spectroscopic evidence of J-transformation of X-rays It is the purpose of this note to direct attention to data of more recent date which would indicate that these so called evidences are caused by experimental inaccuracies in determining the wave-lengths of X-ray emission spectra

It appears from the graph of Khastgir and Watson

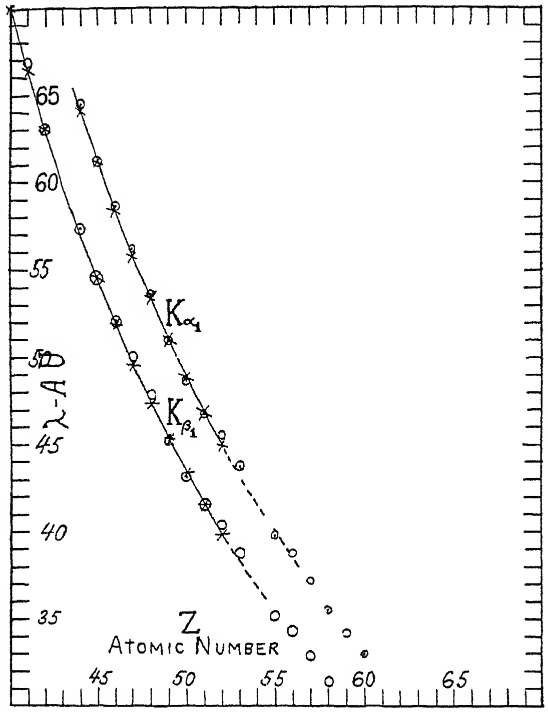

Fig 1

that they used values of λ which were determined by Malmer in 1915 (tabulated in "Atomic Structure" by Sommerfeld, p 153) Siegbahn ('Spektroskopie der Rontgenstrahlen' 1924, pp 101-102), however gives values of λ which in some cases are quite different from those of Malmer I have plotted the values of λ according to Siegbahn's latest work against the atomic number and find that the points fall on a smooth curve, and that there are absolutely no discontinuities These points are indicated by crosses in the accompanying diagram (Fig 1) The dots with circles around them indicate the values due to Malmer Both the $K\alpha$ and $K\beta$ lines are shown in the plot

It would seem, therefore, that Khastgir and Watson have been led into error by experimental inaccuracies and the peculiar coincidence that the greatest deviation from more recent wave length determinations occurred at points which correspond with two of the critical absorbabilities for J-transformation There is, therefore, no spectroscopic evidence of the so-called J-transformation of X-rays

W W Nipper

Washington University,
Saint Louis,
Missouri,
May 19

The Conditions for Calcareous Metabolism in Oysters and other Marine Animals

THE summer of 1924 was remarkable for an unusually large and heavy growth of the shell of native oysters on most beds in England. In a recent survey of the Fal Estuary oyster beds, full details of which it is hoped will be published later, it was found that a total shoot (*i.e.* maximum increase in height or depth of a shell in a ventral direction) of 30 or more millimetres was quite common. Similar large shoots have been observed in shells from East Coast and other beds in 1924. The fact that the summer of 1924 was not a warm one is a matter of common knowledge and of great interest in connexion with the unusual shell-growth. In warm summers such as we had in 1921, a big growth of shell is usual, but is then attributed to the generally increased metabolism following upon a high temperature, when biological conditions are otherwise satisfactory; but the rate of shell-growth of the oyster (*i.e.* increase in shell-area, and total increase in shell-weight) under any continuously known conditions is still undetermined. It is, therefore, not possible to state what are the precise conditions which are essential for normal or abnormal shell-growth. These conditions, like those in many other problems relating to the oyster, may not be determined until greater concerted attention can be given to what is admittedly a valuable mollusc. In the meantime it may be worth while to summarise a few observations on the subject.

Most lamellibranchs increase the area of the shell by the repeated addition of small concentric deposits at the edge. The oyster, however, makes a relatively large more or less concentric deposit of thin shell at one operation; this thin deposit, called a shoot, quickly hardens by being thickened.

Good practical oyster-producers say that two of such shoots are frequent in a fair year of growth, and the radius of each such shoot in a 2- to 3-inch oyster may be about 10 mm. This year on the Fal 3 and 4 such shoots, all with practical but not absolute certainty this year's growth, may be found. The variability in the number of shoots laid down from year to year is the main cause of the difficulty or impossibility of estimating the age of young oysters, without very intimate local knowledge of the growth-features. In an average year of growth it would appear that the two usual shoots are laid down in the spring and autumn, that is, on either side of the warm—and also spawning—period. But growth ceases in winter for an undefined period, even on beds such as those off Whitstable (in 1920–21 for example) where abundant food is available. Moreover the present writer has shown that oysters taken from the beds *in winter* and kept under warm conditions, even in practically sterile (Berkefeldt-filtered) water, will grow shell. (See Fish. Invest. 2, VI, 3, pp. 43-44—owing to the demands of economy it was only possible to give the bare observations in that paper.) Further, oysters kept in the laboratory in summer will lay down shell automatically in the practical absence of food (see NATURE, vol. 111, p. 14). These facts point to a controlling factor represented by a minimum temperature, below which shell is not or cannot be laid down, and above which shell-material may be produced automatically.

There is no doubt that lamellibranchs in general at our latitudes resemble the oyster in their physiological reactions with regard to shell-growth, one example of which is shown by the writer for the cockle, in NATURE, vol. 111, p. 147, Fig. 2. If, therefore, calcareous material be only laid down with difficulty at low temperatures, it would be highly instructive to have chemical analyses of those thin-shelled forms which are found in polar and deep-sea waters. Indeed a deposition of calcareous material by living marine organisms, although made so easily in the tropics, appears to be found increasingly difficult as the habitat becomes colder. One is tempted, therefore, to inquire what may be the chemical composition of the vertebræ or any bony parts of polar and deep-sea fishes. There is a fundamental similarity in living animals which warrants such an inquiry.

It may be noted in passing that the secretion of siliceous matter can be effected at very low temperatures by polar and deep-sea organisms, in some of which it is possible that deposition of silica may replace that of calcareous material.

In the good shell-growth of warm and relatively cold wet seasons, in Great Britain the corresponding hydrographical conditions are respectively high estuarine salinities, alkalinities, and temperatures, and low fluctuating salinities with medium temperatures and (probably) alkalinities; in the wetter seasons one would also expect a smaller amount of available food-material. An explanation of growth which meets the facts partially may be given as follows: shell-deposition in a warm summer is rapid, and any arrest of growth which may be due to breeding is masked, while in the wet summer growth occurs continuously in the medium temperature and low salinity and is only slightly arrested by the generally — but not totally—repressed reproductive phases. Shell-growth may occur in the pre-spawning period of females, *i.e.* in the spring, but requires to be observed more fully in marked individuals in the post-spawning period, in which there is a suspicion of a slowing down of the operation.

The good shell-growth in the summer of 1924 may, therefore, be understood if we assume that repression of the reproductive capacities in the relatively cold summer permitted continuous growth, which was apparently accelerated by the low salinity. The arrest of growth when reproduction is possible in invertebrates is indicated in the diminutive size of the breeding individuals in the summer crops of the sponges, Grantia and Sycon, and the very large size possible in the non-breeding wintering forms of the same genera. There is therefore nothing unreasonable in the explanation of growth so far offered. There is, however, another important type of growth which seems to require a different explanation, namely, that which appears to follow removal of oysters to a fresh habitat. For this type of growth a supposition of a general increase in the well-being of the animal does not seem to be sufficient, nor for the fact that an unusual amount of growth occurred in many stunted forms in the Fal Estuary last summer, except that the low salinities, which can be predicted as a result of the heavy rainfall, would be equivalent to a change of habitat. In this respect it is important to note that in the oyster, and doubtless also in related forms, growth does not necessarily follow a mere accumulation of reserve products, as is shown by the fact that "dumpy" (stunted) oysters, which may constitute 40 or more per cent. of a population, were this year on the Fal mostly very well fished (full of reserve products), while the fast grown oysters were mostly thin and emaciated as though expended in their efforts in growing. Some biological factor appears to shut down the shell-producing mechanism in certain individuals, while in others automatic response to the environment is clearly very prompt. The problem here denoted once more presents the dual interests of science and economics, the boundaries of which cannot be universally defined.

J. H. ORTON.

Marine Biological Laboratory,
Plymouth, June 5.

The Isotope Effect in the Spectrum of Silicon Nitride

RESULTS of a quantum theory analysis of the SiN bands and of the vibrational isotope effect in these bands were given in an earlier letter to NATURE (March 22, 1924) and in a paper presented at a meeting of the American Physical Society (cf *Phys Rev* 23, 554, 1924) It is now found that the equations given in the latter for these bands are incorrect This is due to a wrong assignment of vibrational quantum numbers, corresponding to what may be described as an insidious violation of the combination principle With the data first used, this violation was not apparent, but new data disclose systematic, although rather small, deviations A new and, this time, correct assignment of quantum numbers has now been made The following equation holds for the position of the null-lines of the $Si^{28}N$ bands (n' = vibrational quantum number of the initial, n'' that of the final state of the molecule)

$$\nu = 24234\ 2 + 1016\ 30n' - 17\ 77n'^2 + 0\ 41n'^3 - 0\ 0049n'^4 - 1145\ 00n'' + 6\ 570n''^2$$

The null-lines, it should be stated, can for many of the bands be measured directly on the plates At the low temperature of the active nitrogen used in generating the bands, the null-line appears as a conspicuous hole in the band structure, on the low-frequency side of the head

With the new numbering, the various apparent abnormalities previously noted disappear, and an analogy of the SiN bands to the violet CN bands is brought out In particular, the isotope effect, previously thought abnormally large for the initial state of the molecule, is now completely normal Agreement with the theory is exceedingly good if the emitter is assumed to be SiN No other assumed emitter gives agreement with the experimental data, even for SiO, the agreement is poor Thus the value of the isotope effect in the identification of the emitters of band spectra, emphasised in a previous letter (April 5, 1924), is again confirmed As in the case of the BO bands, so in the case of SiN, the testimony of the isotope effect is backed up by the chemical evidence (NATURE, Sept 6, 1924, and *Phys Rev* 25, 259, (1925))

The agreement of the results with theory is much better if the integral vibrational quantum numbers 0, 1, 2, are assumed than if the half-integral numbers $\frac{1}{2}$, $1\frac{1}{2}$, $2\frac{1}{2}$, are used In this respect SiN differs from BO, for which the data indicate (cf refs last cited) that half-integral values are needed

A detailed account of the work on the SiN bands is now being prepared for publication

ROBERT S MULLIKEN,
National Research Fellow
Jefferson Physical Laboratory
Harvard University,
May 16

Planetary Densities and Gravitational Pressure

IN astronomical works the densities of the sun and planets are taken as the ratios of the masses to their apparent volume, the masses being determined by the periods of the bodies which revolve round them

For the sun itself, and for several of the planets (notably for Jupiter and Saturn), the density so determined is much less than that of the earth and it seems very improbable that this should really be the case, considering that the materials of which they are composed are the same as those which make up the earth, and that the gravitational pressure to which they are subjected is much greater than that which could be produced by terrestrial gravity

In the case of the sun, Venus, Jupiter, and Saturn, in which the visible part is vapour or cloud, it seems most likely that there is a dense nucleus in which most of the mass is concentrated, and, assuming for the moment that the whole mass is so concentrated, it is a simple and direct problem to determine the size of the nucleus for any given density

The depth of the non-solid covering will be the difference between the apparent semidiameter and the radius of the nucleus, and if the latter has the density of the earth, the approximate dimensions in miles are as follows

	Apparent Semidiameter	Radius of Nucleus	Thickness of Envelope
Sun	432,000	278,000	154,000
Venus	3,800	3 600	200
Jupiter	45 000	28 900	16 600
Saturn	37 500	19 000	18,500

If the density depends on the gravitational pressure the diameter of the nucleus will be less than the above for the sun, Jupiter, and Saturn, and rather greater for Venus

There are no experiments on the variation of density of solids under large pressures If a rod of the mean density of the earth is supposed to reach from the surface to the centre, the pressure on its base is just half that which the same mass would exert at the surface when resting on the same area Taking the earth's radius as 21 million feet and the earth s density as 5 6, this gives 11,400 tons per square inch as the pressure at the earth's centre

I have seen no mention of trustworthy experiments at even 100 tons per square inch, and in my own work have never gone beyond 30 tons

In some trials with precipitated chalk, using pressures of 25 tons to the inch, I have obtained blocks with a density of 1 6 to 1 7—much the same as the density of the upper chalk In the lower chalk, however, the density sometimes exceeds 2, and it would be interesting to know whether this is the result of gravitational pressure

A MALLOCK

Spiral Springs of Quartz

I AM greatly interested in the account in NATURE of June 20, p 943, of the manufacture of spiral springs of fused quartz by Dr Slupas, and the comment by Prof Boys on the achievement

During the last eighteen months we have been employing similar springs of fused quartz in this laboratory in the measurement of sorption, a preliminary announcement of their use appearing in the Journal of the Am Chem Soc for December of last year (Bakr and McBain p 2722), and a full account of the sorption balance is now being communicated

Our experiences confirm in every way the observations made by Dr Slupas in his letter Several members of the laboratory have prepared these springs of varying dimensions, using the ordinary coal-gas-air blow-flame for forming the coil (The oxygen-gas flame was, of course, employed for the drawing-out of the fibres from the thick rods of quartz) The quartz fibre is attached by a smear of sealing-wax to an ordinary arc-lamp carbon of suitable dimensions, which is supported in a well-bored cork, so that it may be rotated about its longitudinal axis A small weight is suspended from the free end of the fibre, which is then coiled by slowly turning the carbon rod, the fibre being heated by the blow-flame at the point

at which it is being bent As mentioned in Prof Boys's note, the close or open coiling of the spring may be effected by slight inclination of the rod to the horizontal, and evenness in the winding is readily secured When the coil is completed, it is removed from the rod by gentle tapping, and the hooked ends bent into the axis of the coil We have observed no deterioration of the quartz due to the contact with the hot carbon rod, or to the use of coal-gas

Spirals of fused quartz fibres of from 0 1 to 0 2 mm diameter, having from 15 to 30 coils of diameter 0 5 to 1 5 cm , have been prepared in considerable number Some large springs with coils of 2 cm diameter were made to order by Messrs The Silica Syndicate, and these had the same average extension per unit weight suspended from them as the spring of the same dimensions instanced by Dr Slupas Considerably more sensitive springs have been manufactured, but they were too delicate for the purpose for which they were required There appears to be small limit to the sensitivity that can be obtained, provided that the maximum load required to be carried be small As an example of a typical spring which we are employing—of the less sensitive kind—we can get a spring that will carry a total load of approximately 0 8 gram, giving an extension of 0 9 cm per 0 1 gram load, diameter of coils, 1 3 cm

In the manufacture of long springs we have found it quite easy to join two or more fibres together, using the oxygen flame

H GREVILLE SMITH

The University, Bristol,
June 22

The Quantum Analysis of New Nitrogen Bands in the Ultra-Violet

IN a previous letter (NATURE, 114, 642, November 1, 1924), one of the writers predicted a new group of nitrogen bands with an origin at about 65,000ν, having for its initial state the final state of the first positive group, and for its final state the stable condition of the neutral molecule A group of strong bands in almost precisely the predicted position has now been measured and analysed, but, contrary to expectations the progressions of this group are not related to those of any other analysed group of nitrogen, or of any other substance

The new group was obtained with purified nitrogen, at 0 003 mm pressure, in a long tube, with flowing gas, using ordinary arc discharge The spectrograms contain the usual nitrogen groups and in addition thirty bands degraded to the red, extending from λ1354 to λ1854 Seventeen of the thirty have previously been observed by Lyman ("Spectroscopy of the Extreme Ultra-Violet," pp 82 and 113) The distribution of intensity, except in minor particulars, is similar to that of the second positive group (a typical case), and hence indicates very definitely the correct assignment of vibrational quantum numbers The resulting equation for the new group is

$$\nu = 68{,}956\ 6 + (1681\ 45n' - 15\ 25n'^2) - (2345\ 16n'' - 14\ 445n''^2),$$

where n'' varies from 0 to 9, and n' from 0 to 3 only, the average (Obs —Calc) being 0 1Å

There are many other bands (or at least hazy lines) between λ950 and λ1350, some of which are quite strong, and also a few rather weak bands between λ1350 and λ2100, but as yet no consistent numerical relations are apparent

R T BIRGE
J J HOPFIELD

University of California,
May 11

Sir William Fletcher Barrett, F R S

IN Sir Oliver Lodge's notice in NATURE, June 6, p 880, of the late Sir William Barrett he says that he (Sir William) "claimed" to have discovered some alloys of iron Reference to published scientific papers would have shown Sir Oliver that Sir William read a paper in 1899, published in the Transactions of the Royal Dublin Society in January 1900, on the magnetic and electric properties of the alloy now known as stalloy, which is indispensable in the construction of transformers, dynamos, etc Indeed he was told by an authority that this discovery had saved six million pounds in the construction of the Panama Canal alone Another alloy, permalloy, is likely to be of even greater use in the future

That Sir William did not do much more for original research was due to his extreme conscientiousness, in considering that holding the chair of physics, his first duty was to his pupils, and no private work was ever allowed to interfere with that

Sir Oliver further says that Sir William had "a stimulating hand in founding the Society for Psychical Research" It was entirely due to Sir William's initiative that the society ever came into being, in order to examine obscure psychical phenomena critically and scientifically In this work he encountered much ridicule and hostile criticism, but he never suffered this or the undoubted obstacle thus created to his material advancement to hinder him in his arduous and devoted search for truth

ROSA M BARRETT

I WELCOME Miss Barrett's supplementary letter about her brother's work It is unsafe for a writer of an obituary notice to usurp the functions of a law-court to decide questions of priority or completeness of invention "Stalloy" was, I believe, a subject of controversy, but those who knew Barrett well may hold that any claim made by him must have been well founded As to the initiation of the S P R , Miss Barrett will find a notice in a forthcoming number of the Proceedings of that Society, wherein full credit is given him, with first-hand knowledge, by Mrs Henry Sidgwick

OLIVER LODGE

A Geological Lecture Illustration

THE following illustration, which occurred to me while preparing one of a series of talks to schools for the British Broadcasting Company, may be of interest to those who are concerned in teaching elementary geology, though it may not be new

Almost every one has seen the heaps of sample carpets in large furniture stores Let the carpets represent the successive strata as laid down in past time Now suppose that a thick board or wedge be driven underneath the pile of carpets this will produce a humping up of all the carpets just above the wedge If we then suppose that the humped-up portion is subjected to continuous wear (denudation) it is quite conceivable that the upper carpets will be worn right through and the lower carpets (older strata) become exposed The frayed edges of the worn-away carpets become the escarpments of the upper strata, and the analogy may be easily extended by considering carpets of different textures Other types of deformation may of course be given to the pile, and the geological map subsequent on denudation easily deduced

G N PINGRIFF

Merchant Taylors' School,
E C 1

Problems of the Rhone Delta

By R. D. OLDHAM, F.R.S.

I

IT has long been known that the delta of the Rhone has undergone great changes since the close of the period of Roman empire. The changes are attested by historical records, but the evidence is contradictory; in part it seems to indicate a rapid advance of the sea face of the delta during the Middle Ages, yet there are mentions of places and dry land almost up to the present limit, and there is clear proof that places close to the existing coast-line were dry land and inhabited during the Roman period. These contradictions gave rise to a large volume of discussion, at times very controversial, by archæologists, geographers, and geologists during the last century, but the result was inconclusive, for the key to the solution had not been found. Work done since the beginning of the present century has thrown a new light on the problem, and especially a geological study by M. G. Denizot, which was published in 1924 by the Société Géologique de France, has made a re-examination of the question possible, and led to the possibility of drawing an outline of the changes which have taken place since the dawn of our era.

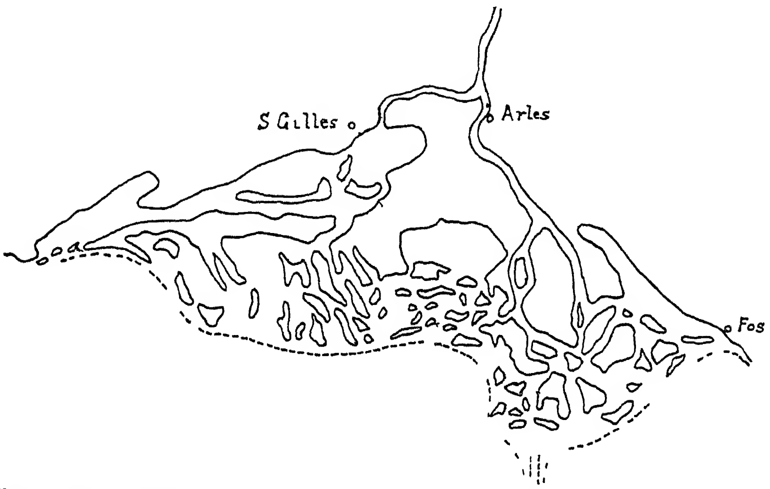

FIG 1.—The Rhone delta about the end of the tenth century. This sketch does not attempt accuracy of detail; it is purely diagrammatic and intended to represent the general type of topography which resulted from the subsidence in the Dark Ages. The outline of the waterways must have been more intricate than can be restored or represented on a small scale map. The broken line represents, approximately, the outline of the delta in Roman times.

On a map of the region, the river Rhone is seen to divide just above the city of Arles into two branches, of which the western flows past St. Gilles and, curving to the southwards, enters the Mediterranean just west of the village and shrine of Saintes Maries, while the main stream, which carries four-fifths of the water, flows southwards to the sea, keeping near the eastern margin of the delta proper. Between these two streams is a triangular tract of country, known as the Camargue, and in the middle is an expanse of salt water, the etang de Vaccarès, which communicated freely with the sea by an island-studded stretch of water before it was cut off by the formation of an artificial protective embankment. As seen on a map, the appearance is that of a normal alluvial delta, where the two branches of the river are bordered by fully developed alluvial plains, while between them is a tract of marshy or flooded country, not yet fully reclaimed from the sea, and as such it has generally been interpreted; some strips of ground, too high to be part of the alluvial plain, being regarded as relics of old coastal barriers, now separated from the sea by the advance of the delta.

The description of M. Denizot puts the question in a different light, for he describes the country round the etang de Vaccarès, on the north, the east and west, as rising to heights of two to three metres, with an undulating surface, the result of subaerial denudation, and in the alluvium forming this high land, he found fossil remains of *Cardium edule*, and other living marine molluscs, at heights of more than a metre above sea-level. As cockles cannot live and thrive above high-water mark, it is evident that, since these deposits were formed below sea-level, there must have been an uplift of the land, and the relation of the present surface to the Roman remains, which are found in this region, shows that this uplift, though extremely recent in the geological sense, must have preceded the advent of the Romans and probably of their predecessors, the Phoceans and Phœnicians.

Though very recent, this uplift is not the most recent change of level which has taken place. In 1903, Mr. R. T. Gunther established for the neighbourhood of Naples a series of regional changes of level, which ended up by leaving the land some twenty feet lower, relative to the sea, than during the Roman period, and, since then, evidence has accumulated of a similar change of level in other parts of the Mediterranean from Venice to Alexandria and Carthage, nor is it wanting along the coast of Provence. In the very region of the Rhone itself remains of Roman buildings have been found below sea-level, in the etang de Vaccarès, and in the Gulf of Fos are remains of old buildings, regarded as remains of the port of Fossæ Marianæ, which was an important seaport in the early centuries of our era.

A very vivid description of these is given by M. Toulouzan, who mentions buildings, and long jetties of stone, as visible beneath the sea in calm weather. The archæology of this writer was so brightly tinged with imagination, that the existence of these ruins has been doubted, or denied, but there is independent evidence of the remains existing under the sea in the Golfe de Fos, and the discovery of remains of Roman construction below sea-level has also been recorded in the étang de Vaccarès. Apart from this, M. Denizot, in the paper referred to, gives evidence of subsidence of the land near Fos, though he denies the possibility of its amounting to anything like nine metres. That some

subsidence of the land has taken place is, therefore, established, but the direct evidence on record, if we except the statements of M Toulouzan, does not give a measure of it For this we must look to the changes which have taken place in post-Roman times, which not only give indirect corroboration of the subsidence, but enable its amount to be estimated, as certainly not materially greater than five, or less than four, metres, and the date to be fixed as in the period which elapsed between the beginning of the eighth and the close of the tenth centuries

One result of the recognition of this change of level is that the current conceptions of the delta in Roman times must be revised The whole region then stood some twelve to fifteen feet higher above sea-level than at present, and, if the land were again to be raised to this level, the whole of the great expanse of water, forming the etang de Vaccarès and extending to the sea, as well as all the salt lakes, which are in more or less direct communication with the sea, or only cut off by alluvial and coastal barriers, would be converted into dry land The delta, instead of being smaller than at present, might have extended farther out to sea than now, the great spreads of pestiferous salt marshes, which render the country almost uninhabitable, would be largely or entirely drained, and instead of the subsoil being everywhere so charged with salt that a supply of drinking water can only be procured by storing the rainfall, it would probably be obtainable from surface wells The country, in fact, would be fertile and habitable, justifying the description of the ancient writers, and accounting for the numerous remains of considerable settlements which have been, and are still being, found Through this region the branches of the Rhone would flow in channels cut out of the upraised alluvium, with a flood-plain on either side, and the mouths would issue on the sea-face, where the action of the waves, driven directly against the bar by the prevailing storms, would give rise to the same difficulties and dangers of navigation as at present, troubles which Caius Marius solved, in the same way as the French engineers of the last century, by cutting a ship canal from the river to the sea

With the subsidence in post-Roman times, a change in the conditions took place In a region where no point rose more than thirty feet above sea-level, the whole of the low lands would be submerged to a greater or less extent, numerous creeks and channels would penetrate the land, converting the gently undulating ground into islands of varying size, separated by channels of varying width and depth, the river, instead of ending on the exposed sea-face of the delta, would debouch into deep and sheltered inlets of the sea, the conditions leading to the formation of a shallow and dangerous bar would be mitigated, and the entry made possible for ships of greater draught and tonnage than before or at present In the network of channels and expanse of shallow water, resulting from this subsidence, the recovery of land from the sea, by the alluvial deposits of the river, would take place with rapidity, the position of the mouth, and the course of the channel, would be continually changing, until the river once more reached the sea-front of the delta One region, however was protected by the accident of configuration of the surface, and while, on either side, the channels were largely filled up by river silt, the great etang de Vaccarès, with the island-studded waters to the south, remained little affected, and have preserved a representation of the conditions which must have been widespread, along the whole of the outer portion of the delta

Besides the numerous salt lagoons, or etangs, which owe their origin to this subsidence, there are expanses of modern alluvium, which, but for the complete embankment of the river, would still be in process of formation This modern alluvium, according to M Denizot, can often be sharply distinguished from the older, prehistoric alluvium, on the undulating, eroded surface of which the Roman settlements were built, in other places the boundary is less easily recognised, but the distinction is none the less complete, and it is largely possible, by an examination of modern maps and a comparison with older ones, to extend his direct observations, and to compile a map which will, at least, give an indication of the general distribution of land and water at the time when the subsidence had ceased, and before sedimentation had been able to make material progress

Such are the deductions which may be drawn from a purely geological study of the region It remains to be seen how far they are consistent with, or supported by, historical records

II

The western branch of the Rhone, which takes off from the main stream just above Arles, flows past St Gilles and then bends southwards to enter the sea by the Grau d'Orgon, near Saintes Maries, but the last part of the present channel, from Silvereal on, dates only from 1552, when the river broke away from its old course Before that date it had followed another channel, farther west, now known as the *Rhône mort*, past Peccais, to the salt lagoons south-east of Aigues-mortes, and in 1532 was diverted from them by a cut direct to the sea, which became known as the *Rhône vif*, the mouth of this channel becoming the *grau neuf* Between St Gilles and Silvereal the river crosses a great expanse of marsh and swamp, which extends westwards towards the etang de Mauguio, and is separated by a barrier of slightly higher land, an inland delta of the Vistre and Vidourle M Denizot refers to this tract, which he recognised as composed of modern, or as we may say, post-Roman alluvium, quite distinct from, and newer than, the older alluvium forming the more elevated undulating surface to the south of it Even now the greater part of this ground can scarcely be described as dry land, it is mostly swamp and, in all but the most recent maps, considerable tracts are shown as permanently flooded It bears all the appearance of being a tract which has been reclaimed by river deposits in quite recent times A relic of this old, and once extensive, sheet of water, which spread over this ground, may be seen in the etang de Scamandre, still about six feet in depth, and evidently bounded by the sloping surface of the alluvial plains of the Rhone on the east and the Vistre on the west

It is not possible, from the information available of a geological or topographical character, to determine whether this sheet of water formerly extended westwards to the etang de Mauguio, for this we must look

to historical records, and foremost among them may be put the history of St Gilles By some writers this place has been identified with the Heraclea, mentioned by Pliny the younger, on the strength of a supposed inscription, which has been wholly discredited by later research That a Roman town stood where it now stands is certain, but this was not Heraclea, for Pliny mentions that place as one which had become legendary, even in his time, and there is not only no evidence, but a strong presumption, that the St Gilles of Roman times was not in use as a port It was otherwise in the eleventh and twelfth centuries, when the Dark Ages were passing away, for at that time St Gilles was not only a recognised seaport, but also the most important one along this coast In 1109 Raymond of St Gilles collected there a fleet of forty ships, to transport an army of four thousand fighting men to the Crusades Three years later the Knights Hospitaller of St John founded their first establishment outside the Holy Land at St Gilles, because it was then the port most used by pilgrims to and from Jerusalem Mention of the use of St Gilles is fairly frequent in the records of the twelfth century, and in 1160 the Rabbi Benjamin of Tudela describes it as a flourishing town frequented by visitors from the most distant lands, situated on the banks of the Rhone, and within three miles of the sea As the sea is now nowhere within five times that distance of St Gilles, and as there is a continuous strip of what must have been dry land, though possibly penetrated by channels, the sea of the Rabbi could not have been the Mediterranean, it could only have been that expanse of water which has been referred to

These accounts give no clue as to the direction in which the navigable channel of access lay, but an incident of the wars between the republics of Genoa and Pisa throws light on this subject Some Pisan galleys, pursued by Genoese, took refuge by ascending the Rhone to St Gilles, the Genoese, instead of following them, went up the main stream, past Arles and, rounding the point of the Camargue, descended the lesser branch of the river to St Gilles The Pisans hearing of their approach fled down stream, as the chronicle reports, by another river and another mouth called the Gradus Capræ, which appears in the French version as Grau de la Chêvre, where the Genoese, in pursuit, captured and burnt some of the galleys and proceeded, searching for more, until they reached the Grau de Montpellier, now called Palavas, where they met a contrary wind and had to return by the river to Arles and so on to Genoa

This is the last appearance in history of St Gilles as a port accessible from the sea In the following century, when Aiguesmortes was founded, in 1240, St Gilles could no longer have been a seaport, it is certain that there was no direct access to it from the étang de Mauguio, and the Grau de la Chêvre of the thirteenth and fourteenth centuries was the mouth of the old river course, of the *Rhône mort* This channel, however, seems not to have been navigable, and it is very questionable whether it was meant, in the record of the naval adventure of 1165, if the statement of the Rabbi Benjamin of Tudela can be accepted, the river had not then extended so far, and the narrator, without definitely stating it, implies that the course from the Grau de la Chêvre to Montpellier was in sheltered waters, and not in the open sea The implication is that the access to St Gilles was from the westwards, and if so its decline and disappearance, as a port of destination, was due to the closing of this channel on one hand, and the advance of the western and smaller branch of the Rhone on the other

This conclusion is strongly supported by a study of those remarkable relics of the Middle Ages known as the portolan maps It is known, from incidental references, that sea-charts of some kind were in use in the twelfth century, but they appear to have been mere sketches, drawn from memory by navigators, of the approaches to individual ports, or of stretches of coast-line, only towards the end of the thirteenth century did the normal portolan appear This gave a representation of the Mediterranean and Black Seas, and of parts of the Atlantic coasts of Europe and Africa, with a surprising degree of accuracy The origin and history of these maps have been the subject of much discussion, but it is generally agreed that they were sea-charts made for the use of sailors, that they originated independently of, and were uninfluenced by, any earlier maps, and that, once the type had developed, they went on being reproduced, with merely variations in detail, throughout the succeeding centuries until the seventeenth or even into the eighteenth century

In the region of the Rhone Delta, the maps all represent a broad inlet of the sea, stretching from Cette to the Rhone, drawn in a conventionalised outline and dotted over to represent shoal water To this statement an exception must be made of a few of the earliest maps, in the very earliest, the Carte Pisane of the end of the thirteenth century, the representation of the mouth of the Rhone is so purely conventional that no conclusion can be drawn from it, of slightly later date, 1318, are two maps by Petrus Verconte, of very different character and great interest They represent a great inlet of shallow water, extending from just east of Cette, over the étang de Mauguio to beyond where St Gilles would be, were it marked on the map, and, more than that, one of these maps also shows a sheet of water, north-eastwards of the termination of this inlet, in the position of the tract of land, between St Gilles and Beaucaire, which was permanently flooded until it was drained by the digging of the canal from Beaucaire to Aiguesmortes In neither of these maps does the inlet extend to the Rhone, but stops short, and at the eastern end a river is shown entering it, which must be meant for the western branch of the Rhone

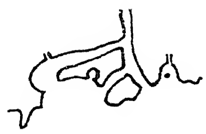

Fig 2 —Coast line between Cette and Cap Couronne from the Catalan Atlas of 1375 This shows the general type of the representation of the Rhone Delta which runs with small variations through the whole series of the portolan maps, with the exception of the early one by Petrus Vesconte, shown in Fig 3

It is impossible to examine these maps without being struck with the facts, that they evidently owe nothing to any pre-existing map of which we have any knowledge, and that they are equally evidently an attempt to represent something which really existed The author of the general map must have had before him a local chart of this region, probably one of those mentioned above, which had been drawn at a time when St Gilles was still a port, but this was a century before

the map was drawn, and so the omission of the name of St Gilles can be accounted for Vesconte knew that there was no longer a port of St Gilles, if he knew that there ever had been, and, being of no interest to those for whom the map was made, it was omitted, but the topography he took, directly or indirectly, from the older map If this map is compared with a restoration of the twelfth century topography, as deduced from modern maps of the region, the agreement, as regards the eastern end of the inlet, is so close, that his representation of the western portion, where direct restoration is more uncertain, may be taken as corroboration of the western approach to the port of St Gilles

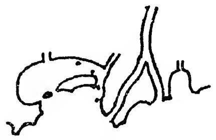

FIG 3 —Coast between Cette and Cap Couronne from the map by Petrus Vesconte, dated 1318

The later history of these maps, so far as it affects this region, may be briefly summed up The Vesconte map is the last which gives an air of reality to the western channel, and it is probable that in contemporary maps, by other makers, the representation had already assumed the conventional form, seen in the Dulcert map of 1339, and repeated throughout the series of later maps At the same time, there is a great advance in the representation of the sea-face, which maintained a remarkable correctness until about the middle of the fifteenth century, after that, a change of conditions, by deterioration of the channels of access to Arles and Aiguesmortes, and by the increase in size of the merchant ships, led to this coast being avoided by the mariners who used these charts, and a steady deterioration set in, due to errors introduced by repeated copying, uncontrolled by any check

From the evidence outlined above we may reconstruct the history of St Gilles as a seaport In Roman times it was an inland town, of no great importance, past which one of the branches of the Rhone flowed, as at the present day, but, instead of turning southwards, the river flowed on to the west, in a valley cut out of the upraised alluvium, to where the etang de Mauguio now stands Then came the subsidence in the Dark Ages, the lower part of this valley became submerged, and an inlet of the sea was formed, with sufficient depth of water to enable ships to reach St Gilles, which, by 1080, had become so well established that it was selected as the most appropriate landing-place for a princess of Sicily, on her way to the Court of France The importance and prosperity of the port increased during the succeeding half-century or more, but, once further subsidence of the land had ceased, the alluvial deposits of the river began to advance into the flooded lands until St Gilles, instead of being a port on an inlet of the sea, became a town on the banks of a small river, and at the same time the rivers Vistre and Vidourle, entering the inlet near its western end, built up a barrier across it These two causes, combined, made access from the sea to St Gilles increasingly difficult until, by the end of the twelfth century, its life as a seaport had come to an end Since then, the remains of this old inlet were gradually filled up by silt deposited from the flood-waters of the rivers, and the process would still be going on, if these rivers had not at last been completely hemmed in by flood-proof embankments

(To be continued)

The Centenary of the Railway

By Engr -Capt EDGAR C SMITH, O B E, R N

THE celebration of the centenary of the opening of the Stockton and Darlington Railway is an occasion of world-wide interest, for from that pioneer line has sprung the vast network of railways which stretches to the uttermost parts of the earth It was the first of British public steam railways, and just as the Romans were the great builders of roads, so our race became the great builders of railways Even as British ships navigate every sea, so railways designed by British engineers traverse every continent The modern textile industry and the steel industry both had their birth in our isles, but it is probable our three greatest contributions to material progress were the steam-engine, the steam-ship, and the locomotive Watt and Stephenson, like Shakespeare, Newton, and Faraday, have been eulogised beyond measure, but we are perhaps even now too near the revolutions they set in motion to realise their full significance in the history of mankind

The Stockton and Darlington Railway was opened on September 27, 1825, when George Stephenson drove his famous engine *Locomotion* from Darlington to Stockton with a train of miscellaneous vehicles and trucks filled with goods and passengers That great experiment must always be associated with the name of Stephenson, who, however, was but the outstanding representative of the pioneers of the steam railway to whom tribute should be paid Tracks of wood and wheels of iron had been in use for many years In 1801 William Jessop had built the first authorised public line, the Surrey Railway It was probably Jessop who gave us our gauge of 4 ft 8½ in By 1820 railways were becoming common, and no fewer than twenty were sanctioned in that year alone These were worked by horses In the eighteenth century, Cugnot, Murdock, and Trevithick had all built steam-carriages, and in 1804 Trevithick set a locomotive to work on an iron track in Wales In this engine he used the exhaust steam as a blast Two or three years later Trevithick had one of his engines running round a track where Euston Square now stands Blenkinsop's engines with cogged wheels date from 1812, and about the same time Foster and Hackworth assisted Hedley to construct *Puffing Billy* and *Wylam Dilly*, the two oldest locomotives now extant Stephenson's first Killingworth engine *Blucher* was built in 1814, his second in 1815, and eight years later, with assistance from Pease, Richardson, and Longridge, he opened his engine factory at Newcastle, where *Locomotion* was built

Originally projected by Edward Pease as a mineral line for bringing coals from near Bishop Auckland to the sea, the plans for the Stockton and Darlington Railway were passed in 1821, and two years later, largely through Stephenson, powers were obtained for

carrying passengers and for using locomotives, the general idea being to use locomotives on the level and stationary winding engines for the inclines At first *Locomotion* was the only locomotive, but it was soon followed by other engines afterwards named *Hope, Black Diamond, Diligence,* and *Royal George,* for it was found that "an intercourse and trade seemed to grow out of nothing" Stephenson by now was also engineer to the vastly more important railway, the Liverpool and Manchester, and just as he had prevailed upon Edward Pease to use the locomotive for the Durham line, so he converted the proprietors of the Lancashire line to his ideas When the line was nearing completion a prize of 500*l* was offered for a locomotive fulfilling certain conditions, and the remarkable success of the *Rocket* at the historic Rainhill trials held in October 1829 sounded the knell of both horse railway and stationary-engine railway A year later the Liverpool and Manchester Railway was formally opened by a procession of eight locomotives, headed by the *Northumbrian,* driven by Stephenson, and with that event the era of the steam railway set in

Railway progress since those early days has been due to two great schools of engineers the mechanical engineers devoted to the design and construction of rolling stock, and the constructional engineers responsible for the track To the former belong both George and Robert Stephenson, Hackworth, Bury, Crampton, Gooch, Fairlie, Ramsbottom, Baldwin, Webb, Belpaire, Borsig, de Glehn, Mallet, Pitkin, and Vauclain, whose names have been household words Between the *Rocket,* weighing with her tender $7\frac{1}{2}$ tons, and the giant *Virginia,* built by the American Locomotive Co, weighing 450 tons, lies the work of a great army With her fire-box surrounded with water spaces, her copper tubes and her direct drive, the *Rocket,* compared with anything which had gone before, was as a racehorse to a dray horse It was in the *Planet,* however, that the cylinders were placed under the smoke-box with the driving wheels aft as we have them to-day

In the history of the locomotive it is impossible to say too much for Howe's invention of the link gear, which gave the driver a simple means of reversing, and also of regulating the cut-off in the cylinder The link gears of Walschaerts, Gooch, Allan, and Joy were all later than Howe's invention, which was made in 1842 Other landmarks in the history of the locomotive are the brilliant invention of the injector by Giffard, the introduction of his ingenious water trough by Ramsbottom, the use of compounding by Mallet and Webb, and the introduction of superheating, notably by Schmidt But in truth every part of the engine and boiler, tubes, valves, gauges, cylinders, pistons, springs, bearings, axles, and cranks, have been the subjects of close investigation and continual improvement In the development of rolling stock, special mention should be made of the invention in 1869 of the Westinghouse brake, while we are also indebted to the United States for the Pullman carriage and the Swift refrigerator car Scientific research has long been the handmaid of locomotive engineers, and it is worth recalling that August Wohler's epoch-making work on materials began with the study of axles

Just as Stephenson was the first to build an iron railway bridge, so he was the first to lay a line across a bog and to drive one through a hill There can be no denying him the title of "the father of the railway" After the Liverpool and Manchester line came the London to Birmingham, then the Grand Junction continuing this line to Liverpool, and the South Western, South Eastern, and Eastern Counties Railways With these and other railways at home and abroad are associated the names of Robert Stephenson, Locke, Brunel, Berkley, Errington, Vignoles, Bell, Hawkshaw, and Brassey On some of the lines were works of great magnitude Of the early bridges the most remarkable was the Britannia Bridge over the Menai Straits Its originality, its great length, its height, and the audacity and skill displayed in raising the immense spans to the top of the towers created as much interest in the public mind as the building of the *Great Eastern* in the next decade Robert Stephenson and Fairbairn were the engineers of the bridge, and for Fairbairn, Hodgkinson carried out his important inquiries on the strength of iron structures The Britannia Bridge was opened in 1850 Five years later a railway bridge was thrown across Niagara by Roebling, and the year 1859 saw the opening of the Victoria Bridge over the St Lawrence, of Lohse's bridge across the Rhine at Cologne, and of Brunel's bridge over the Tamar These bridges, of course, were all built of iron, but with the steel age came even more remarkable structures, such as the Forth Bridge, containing sufficient steel to build two battleships, and the Victoria Bridge over the Zambezi River, high enough to overleap St Paul's

Less spectacular than bridge-building, but of equal importance in the development of railways, has been the art of tunnelling The first railway tunnel was that on the Canterbury and Whitstable line The elder Brunel's Thames tunnel, begun in 1824, was not a railway tunnel, but it led to the invention of the shield, which, improved by Greathead, has been used for all our tube railways But the romance of tunnelling centres around the Alps First came the Mont Cenis Tunnel, then the St Gothard, then the Arlberg, the Simplon and the Lotschberg These have a combined length of 46 miles It was in the Mont Cenis Tunnel, begun in 1857 and finished in 1871, that Graddoni and Sommeiller, through Colladon the physicist, first used compressed air, and it was reading of their work which gave Westinghouse the inspiration for his brake To the lay mind there is nothing more marvellous than the boring of long tunnels from the opposite sides of a massive mountain range, and making them meet within a few inches The total discrepancy in the alignment of the Simplon Tunnel, 12 miles long, was only $3\frac{3}{8}$ inches Tunnelling, like all railway work, may be said, in the words of Emerson, to be "girt about with a zodiac of sciences, the contributions of men who have perished to add their point of light to our sky" If men had not followed the motion of the stars pored over the mystery of light, or studied fossil forms the Alps would still have remained as great a barrier to the traveller as they were to the armies of Hannibal and in commemorating the centenary of the railway we do homage alike to those who have enlarged the boundaries of knowledge and to those who have applied that knowledge to useful ends

Current Topics and Events

THE Committee which is to be charged with the responsibility of advising the British Government on Empire problems involving scientific investigation is to be called the Committee of Civil Research A Treasury Minute issued on June 24 stated that it will be a Standing Committee reporting to the Cabinet, analogous in principle to the Committee of Imperial Defence "The president of the Committee will be the Prime Minister, and the regular chairman, in the absence of the Prime Minister, will be a minister nominated by him for the purpose, the membership of the Committee will, as in the case of the Committee of Imperial Defence, consist of such persons as are summoned by the Prime Minister, or the chairman on his behalf The Committee will be an advisory body and will have no administrative or executive functions It will be charged with the duty of giving connected forethought from a central standpoint to the development of economic, scientific, and statistical research in relation to civil policy and administration and it will define new areas in which inquiry would be valuable" We must confess that this announcement altogether destroys the high hopes raised by the statement made by Lord Balfour in the House of Lords on May 20 It cannot be too strongly urged that the analogy between the Research and Defence Committee has been carried too far The expert is in the ascendancy at the Admiralty, the War Office, and the Air Ministry He has considerable weight given to his opinions, and ministers are not infrequently forced to bow to his judgment on matters of defence But in matters relating to scientific research in connexion with State departments, this is not the case The permanent administrative officers in charge of departments are those to whom reference is made, and they determine whose and what advice is to be followed Until more information is forthcoming regarding the new Committee, we hesitate to pass final judgment upon it For the moment, however, it appears to us that the administrator has triumphed not only at the expense of the scientific worker, but also at that of the Empire as a whole

IN the course of his reply in the House of Commons on June 29 to a motion of censure on the Government for its handling of the problem of industrial depression and unemployment in Great Britain the Prime Minister, Mr Baldwin, made some noteworthy remarks on the relation of scientific research to industry "No one," he said "will assert that British industry can be saved by science alone, but until scientific methods and scientific men can take their place in industry, and an equal place with the administrator and the financier, British trade will never be strong enough or resilient enough to meet the sudden and unexpected changes which will always arise in international trade" Mr Baldwin thinks that "the present situation in industry will cause our people more and more to turn their minds to what scientific research and scientific management can do" Speaking of expenditure on research, he stated that "the electrical industry to-day is spending a quarter of a million a year on research—an impressive figure for this country—but there is one company in the United States of America that is now spending 9,000,000 dollars a year and has 3000 trained workers in its research laboratories, and is going to increase that number to 5000, and there is no doubt that victory in the long run will go to the nation which can harness most efficiently and more securely science to its industry" He also referred to Government expenditure through the Department of Scientific and Industrial Research, and to the twenty-four industrial research associations now in being, in order to "show how I regard it as vitally important to link up science with our industries to-day and to say that the Government will always consider in what way they can best help in the attainment of this great object"

THE problem of low temperature carbonisation of coal received special mention in Mr Baldwin's speech The present position, according to Mr Baldwin, is that "research has been going on at the Government station and by various processes in private hands, several of which have reached remarkable results so far as the laboratory is concerned The time has not come yet when a commercial process has been successfully devised" He stated that he is convinced that "what has been proved successful in the laboratory will be proved successful commercially If the results of the new experiments at East Greenwich justify it, the Government will certainly consider the question whether they might not erect a plant upon a commercial scale to help in the development of this scheme"

THE third triennial conference of the International Astronomical Union is to be held at Cambridge during the week July 14–22 under the presidency of Prof W W Campbell, formerly director of the Lick Observatory, and now president of the University of California The meetings will commence with an inaugural ceremony at the Senate House of the University, when it is hoped that the Earl of Balfour, Chancellor of the University, will welcome the conference The work of the Union is necessarily largely done at the meetings of its many committees, but the General Assembly will meet on four mornings for general business and for the ratification or modification of the reports of the committees Among visitors from abroad who are expected to be present at the Conference we may mention Prof Baillaud M le Comte de la Baume Pluvinel, Prof Bigourdan, and General Ferrie from France, Miss Cannon, Prof E W Brown, Prof S A Mitchell, Capt Pollock, Dr St John, Prof Schlesinger, Prof Shapley, and Dr van Maanen from the United States, Prof Cerulli and Prof Abetti from Italy, Prof W de Sitter, Prof Hertzsprung, Prof Nijland, Prof van Rhijn, and Prof Zeeman from Holland, Prof Chant, Dr Henroteau, Prof J C McLennan and Dr J S

Plaskett from Canada, with Dr H Spencer Jones and Senator A W Roberts from South Africa, Dr Comas Sola and Prof Herrero from Spain, Prof Nagaoka from Japan, Prof Zeipel and Dr Lundmark from Sweden, Prof Stroobant from Belgium, Prof Voûte from Java, and Prof Wolfer from Switzerland The tale is far from complete, but it is clear that Prof Fowler, the secretary of the Union, may look forward confidently to a successful gathering and to much useful work being done

We have received from Prof E H L Schwarz, of Rhodes University College, Grahamstown, a letter claiming the recent age of the Taungs skull, on the ground that the change in geographical conditions at the locality may be of modern date, in accordance with his view that the climate of South Africa has undergone a great desiccation in the course of the past century He therefore considers that forests suitable for great apes may have survived near Taungs until recently Prof Schwarz adds "The Taungs skull was associated with a large number of brain casts of young baboons Mr F Y FitzSimons informs me that the cave-dwellers of the Zitzikamma used to eat young baboons, the rock shelters are full of bones, but the skulls are all intact, showing that the men did not fancy eating the brains It is probable, therefore, that the young Australopithecus, whose remains have been preserved to us, had been caught as prey by a man of the period What nature of a man was he? When the bone breccia of Broken Hill, Rhodesia, was first discovered, some very distinctive stone implements were found in it, it was only long afterwards that the skull of Rhodesian man was found in the same deposit The artefacts are made of clear vein quartz, and are of quite a different type from all other South African ones I had previously obtained them from the Great Brak River, Mossel Bay, while we have almost identical ones in the Albany Museum, from the Bezuidenhouts River, Johannesburg The Rhodesian race was, therefore, widely distributed throughout South Africa, so the man who snared the young Australopithecus probably belonged to it"

A scheme for a very large transmission network for electric power in the eastern part of the United States will probably come into operation in the immediate future It will link together Washington, Baltimore, Philadelphia, New York and Boston with two of the principal coal-fields in America and with a hydro-electric station obtaining power from the St Lawrence Rapids Many small water power plants in the mountains of New York State will also be linked with the network As the St Lawrence Rapids are about 300 miles away from the centre of distribution, it is proposed to use the very high pressure of 300,000 volts As 220,000 volts are already used in California, the American engineers do not anticipate any difficulty To diminish the inductance of the transmission lines and to prevent brush discharges, several aluminium conductors in parallel will be used instead of one copper conductor The very large steam plants in New York, Philadelphia, and Boston, all of which obtain their coal by water transport, will supplement the steam power plants in the mine fields and the hydro-electric plants Luckily abundant feed water is obtainable near the mine fields The hydro-electric plants will run at full load continuously, the steam plants only being used when the demand exceeds the capacity of all the hydro-electric plants All manner of labour-saving devices and apparatus for increasing the efficiency can be employed in very large power stations It is estimated that when this scheme is put into operation, it will save millions of tons of coal per annum as well as greatly increase the total power available

On June 25 the Johnston-Lavis Geophysical Collection, bequeathed to University College, London, under the will of the late Dr Henry Johnston-Lavis, formerly professor of vulcanology in the University of Naples, was formally thrown open to the public by Sir Henry Miers The collection contains a complete and unique series of specimens, maps, books, lantern- and microscope-slides illustrative of South American vulcanology since historic times, as well as collections of rocks and minerals from other parts of the world The collection of Vesuvian minerals, in particular, is probably the finest in the world, and contains most of the species listed by Zambonini in his "Mineralogia Vesuviana" Of particular importance are the large number of specimens of the rare minerals aphthitalite, nocerite, and chlormanganokalite, the latter mineral being discovered by Dr Johnston-Lavis himself in the eruption of 1906, and afterwards described by him and L J Spencer The crystals of aphthitalite and idocrase described by France are also in the collection There is, in addition to the Vesuvian and other minerals, a small but very fine collection of ores from the lead-zinc mines of Laurium, Greece, the smithsonites, aragonites, and aurichalcites deserving special mention There is a large hanging geological map of Vesuvius prepared by Dr Johnston-Lavis, showing the distribution of all the lavas since historic times, and a large collection of guasches, coloured prints, engravings, etc, of past eruptions, and a unique library of vulcanological literature dating from 1508 The collection which is temporarily housed on the two upper floors at 134 Gower Street, is available to the public for purposes of inspection or research on application to the office at University College, Gower Street, London, W C 1

The American Ambassador, Mr Alanson B Houghton, unveiled a tablet in the library of the Royal Aeronautical Society on June 29 to the memory of the British and Americans who lost their lives in the wreck of the R 38 on August 24, 1921 It will be recalled that the airship was built originally for the British Navy, but, on the decision being taken to abandon experimenting with airships, was sold to the United States It was undertaking a flight carrying a mixed crew of Royal Air Force and United States Navy men together with some of the scientific staff of the National Physical Laboratory, when it broke its back and came down in the Humber,

only four of the crew being saved Prof L Bairstow, in thanking the American Ambassador for performing the unveiling ceremony, stated that the failure of R 38 was a great misfortune to airship development In his opinion, the airship would bring many achievements, which at present would be regarded as remarkable, within human range, for example, 24 hours from the limits of civilisation to the North Pole or 100 hours from London to India He also referred to the development of methods of handling airships, and in conclusion stated that, as representing British scientific aeronautics, he hoped that progress would be based on knowledge—that is, research—as part of the tribute which the nations owed to those who had gone before

SIR GEORGE A WILLS, Bart, who with his brother the late Mr H H Wills provided means for the erection of the new University buildings recently opened in Bristol by His Majesty the King, has promised a sum of 75,000*l* for the extension of the Museum and Art Gallery buildings erected in 1904 by his cousin the late Lord Winterstoke By this gift the exhibition space of the Museum and Art Gallery will be more than doubled, and a much needed opportunity provided of relieving the congestion in all departments which has become very marked during the last few years The new buildings will be a backward extension of the present Art Gallery and Museum buildings and adjoining the new building of the University, with which they will be in communication The site area is about 1860 square yards and will allow of the provision of store buildings and staff rooms It is hoped the work will be completed in two years

FURTHER details of his Arctic flight are given by Capt R Amundsen in his full story published in the *Times* on June 23 The position where he descended in order to take observations, and from which he afterwards returned, is now given as lat 87° 43′ 2″ N, long 10° 19′ 5″ W While searching for a landing-place among the floes, Capt Amundsen had been a little farther north The two machines descended at some little distance apart One was abandoned, the crew falling back with some difficulty on the other aeroplane, which was freed from the grip of the ice after long efforts The chief difficulty then to be faced was the provision of a level run for starting The rapid drift and continual screwing of the pack for a time destroyed all attempts At length a track 1800 feet long and 36 feet wide was completed, and by reducing the load to 4180 lb the explorers contrived to get a start Then all went well until in close proximity to Spitsbergen they were forced to make a brief halt on the surface of a rough sea before reaching North Cape safely Capt Amundsen's full account of his journey reveals no scientific results of importance, and none was anticipated

ON Friday, June 26, a meeting was held at Dorchester House, Park Lane, by the kind invitation of Sir George and Lady Holford, when Dr G Claridge Druce was presented with a book plate, the gift of 250 friends and members of the Botanical and Exchange Club The presentation was made by Viscount Grey of Fallodon, who referred in his brief address to Dr Druce's great botanical knowledge, and dwelt on the kindness which he has shown in putting that knowledge freely at the disposal of others, and his power of inspiring interest while imparting it Dr Druce replied, and expressed his thanks for the gift, and his pleasure that it should have been given by Lord Grey, whose love of Nature is so well known He spoke of the work of the Botanical and Exchange Club, and referred also to the discoveries which have been made by the members in recent years and to the measures which are being taken to prevent the extermination of rare British plants Dr Scott then moved a vote of thanks to Sir George and Lady Holford for allowing the meeting to be held in their beautiful house About eighty of the subscribers were present at the meeting

IT was interesting to note at the close of the War that the Constantinople Museum, thanks in great measure to its Director, Halil Bey, showed less sign of disintegration than many other departments of public life Nor was it long before its archæological activities were resumed, and useful work, if not on a very extended scale, was done The Constantinople correspondent of the *Times* in the issue of June 25 describes excavations now being carried on by the authorities at Kadikeuy—the ancient Chalcedon The foundations of a building about 90 feet long and built of big blocks many roughly cut, have been brought to light A fragment of stone containing a cross and surrounded by moulding suggests that the building probably was Christian, and may have been the famous church of St Euphemia in which the Great Council was held in the year 451 Other signs of an active interest in archæology among the Turks are to be noted, especially the excavation of tumuli in Angora, the institution of a new branch of the Museum for Assyrian and Hittite monuments, and a new museum for objects of Turkish culture, as well as the projected formation of an ethnographical museum under Halil Bey and Jelal Essad

SIR RONALD ROSS will open the new building of the British Mosquito Control Institute at Hayling Island, Hants, on Monday, August 31, when a party of members of the Section of Zoology of the British Association, which will then be in session at Southampton, will visit the Institute The building has been designed to carry on work relating to the study and control of British mosquitoes, which was begun at Hayling Island in 1920 by Mr J F Marshall and a local committee, and has resulted practically in ridding the Island of what was once an intolerable nuisance The chief offender was found to be the salt-water mosquito *Ochlerotatus detritus*, which breeds in intertidal areas and is common at many seaside watering-places Before any anti-mosquito measures can be carried out successfully, it is necessary to identify the chief species prevailing in a district, and as the work at Hayling has become known numerous specimens have been sent there for identification and for advice as to the best methods of dealing

with them It seemed desirable, therefore, to provide a special building to deal with what has grown from a local to a national organisation, and this building, which will contain a demonstration museum, laboratory, drawing-office, photographic room, and other facilities for instruction and research on British mosquitoes and anti-mosquito measures, will shortly be completed Among the distinguished entomologists and other naturalists who have consented to serve as members of the Council of the Institute are Major E E Austen, Dr Andrew Balfour, Sir James Crichton-Browne, Col S P James, Prof H Maxwell-Lefroy, Dr G A K Marshall Prof E B Poulton, Sir Arthur Shipley, and Sir William Simpson

IN pursuance of the policy already announced, by which the functions of scientific research and technical development, which were formerly combined in one directorate have been divided between two directorates, both under the supervision of the Air Member for Supply and Research Sir Samuel Hoare, Secretary of State for Air, has appointed Mr H E Wimperis to be Director of Scientific Research, and Mr D R Pye to be Deputy-Director of Scientific Research under the Air Ministry Mr Wimperis has been acting provisionally for some time as Director of Scientific Research He received his engineering training at the Imperial College of Science, London, and at Cambridge After several years with important engineering organisations he joined the engineering staff of the Crown Agents for the Colonies, and on the outbreak of war began his intimate association with aeronautics, undertaking experimental work both for the Royal Naval Air Service and the Royal Flying Corps, particularly with regard to navigational and armament devices He became, on its inception in 1915, head of the Royal Naval Air Service, now the Air Ministry, Laboratory at the Imperial College of Science and has held that position continuously since He is the author of several works dealing with the internal combustion engine and air navigation and of a number of scientific and technical papers Mr Pye is a fellow of Trinity College, Cambridge and is at present lecturer in engineering at the College He was trained at Cambridge, afterwards becoming chief assistant to Prof Jenkin, who was in charge of engineering studies at the University of Oxford During the War he joined the Royal Flying Corps, and was posted for duty as an experimental officer, later he served at the Air Ministry, acting as scientific assistant to Colonel H T Tizard, Deputy-Controller of the Technical Department Since then he has been working at Cambridge, and has carried out research work in relation to aero engines

A SEVERE earthquake is reported to have occurred on June 27 on the coast of California Santa Barbara seems to have been most affected, and according to an account by the New York correspondent of the *Times*, the main street has been broken up and many of the buildings of the city destroyed The High School, the County Hospital and the Arlington Hotel are referred to in particular as badly damaged A seismic wave is stated to have flooded low-lying land along the coast Twelve deaths have been reported Shocks were also felt in Butte, Anaconda, Great Falls and Billings

IN connexion with the 250th anniversary of the founding of the Royal Observatory, Greenwich, and to meet the delegates to the International Astronomical Union, the Royal Society is holding a conversazione on Thursday, July 23, at 9 o'clock

PROF BOHUSLAV BRAUNER, Director of the Chemical Institute of the Charles University of Prague, has been elected an honorary member of the Russian Physico-Chemical Society, Leningrad

COMMEMORATION DAY at Livingstone College, Leyton, was held on June 10 There was a good gathering of old students and others under the chairmanship of Dr Andrew Balfour, who delivered an address Dr Tom Jays the Principal reviewed the work of the College during the past year and appealed for further funds, 800*l* being needed to close the financial year without deficit

A PARTY will leave London on July 31 for a holiday, lasting fifteen days, and for field work in geography, geology botany, and regional survey in the Vale of Chamonix and on the slopes of Mont Blanc This area is classic ground The members of the party will go over some of the ground covered by the pioneer workers H B de Saussure, Forbes, Tyndall, Vallot, and Ruskin, and attempt to continue their investigations Particulars of the arrangements may be obtained by sending a stamped, addressed envelope to Mr Valentine Davis, Cheshire Training College, Crewe

MR P MORLEY HORDER has been appointed architect for the permanent buildings of the London School of Hygiene and Tropical Medicine to be erected on the site adjoining Keppel Street Gower Street and Malet Street, near the British Museum It will be remembered that the funds for the erection of the new building are being provided by the Trustees of the Rockefeller Foundation, who offered the British Government the munificent gift of nearly half a million sterling for site, building and equipment

THE Jerusalem correspondent of the *Times* states in a dispatch which appears in the issue of June 19 that Mr Turville Petre, in the course of excavations by students of the British School of Archæology, has discovered the front part of a human skull of Neanderthal type in a cave near Tabzha, to the north of Tiberias It is said to show the marked characteristics of the type in the highly developed supraorbital ridges, the receding forehead, and the thickness of the bone The cave in which it was found is below well-defined historical levels and contains, under a layer of fallen roof stones, a six feet couch of soil rich in Mousterian implements

WRITING from Finsbury Technical College, London, E C 2, Mr H M Atkinson informs us that while cycling on June 21 from Norwich to Cambridge, he counted more than sixty dead birds on the road, including wrens, starlings, sparrows, finches and a

(?) hawk, together with several small rodents Mr Atkinson noted that birds rose and flew across the road at his approach but were able easily to avoid the bicycle Apparently they are not so successful in avoiding motor-cars Mr Atkinson suggests that head-lights at night, or the polished, tarred road-surface itself during the day time, may have proved the attraction bringing the animals to the road, where they readily fall victims to fast traffic

THE course of lectures delivered by Mr W A F Balfour-Browne to a juvenile audience at the Royal Institution last Christmas is to be published by the Cambridge University Press under the title of "Concerning the Habits of Insects" The same house will also issue Sir J J Thomson's Fison Memorial Lecture on "The Structure of Light" It is expected to be ready in July

APPLICATIONS are invited for the following appointments, on or before the dates mentioned —A lecturer in the department of civil engineering, architecture, and building in the Bradford Technical College—The Principal (July 8) An assistant pathologist to the Jessop Hospital for Women and the Children's Hospital, Sheffield and demonstrator of pathology in Sheffield University—The Registrar of the University (July 11) A senior research assistant at the Building Research Station of the Department of Scientific and Industrial Research—The Secretary, 16 Old Queen Street, S W 1 (July 20) Two probationer naturalists (one with special qualifications in mathematics and a knowledge of biometry and statistics, and one with natural history qualifications, preferably with subsidiary physiology) under the Fishery Board for Scotland—The Fishery Board for Scotland, Edinburgh (July 31) Temporary assistant chemists in the Government Laboratory—The Government Chemist, Clement's Inn Passage, W C 2 (July 31) The professorship of anatomy in University College, Dundee—The Secretary and Registrar, University, St Andrews (August 1) The William Prescott chair of the care of animals—causation and prevention of disease—in the University of Liverpool—The Registrar (September 15) A lecturer on tropical hygiene at the London School of Hygiene and Tropical Medicine—The Secretary, 23 Endsleigh Gardens, N W 1 Head of the commerce department of the Portsmouth Municipal College—The Secretary, Offices for Higher Education, Municipal College, Portsmouth A physical laboratory steward at the Woolwich Polytechnic—The Principal A woman teacher of physiology at the Chelsea Polytechnic—The Secretary, Chelsea Polytechnic, S W 3 A technical assistant at the Royal Aircraft Establishment, South Farnborough, Hants, for work in connexion with photography, with special application to aerial photography—The Superintendent (quoting A 76) A junior technical assistant at the Royal Aircraft Establishment, South Farnborough, Hants, for experimental work in aerodynamics—The Superintendent (quoting A 75) A junior technical assistant at the Royal Aircraft Establishment, South Farnborough, Hants, for general physical work in connexion with instruments—The Superintendent (quoting A 66)

Our Astronomical Column

NOVA PICTORIS —A letter from Mr H E Wood, of Johannesburg, contains the interesting announcement that the Nova has been identified with a star of magnitude 11 0, on the C P D photographic scale, which appears on photographs taken with the Franklin-Adams Star Camera on March 17 1914, March 18, 1914, February 10, 1921

Its brightness before the outburst is slightly less than that of Nova Aquilæ 1918, and considerably less than that of T Coronæ

The position for 1925 0 is R A 6^h 34^m 57^s 2 S Decl 62° 34′ 33″ annual precession $+0^s$ 528, S 3″ 02 Dr H Spencer Jones stated at the meeting of the British Astronomical Association on June 24, that the Cape photographs of the spectrum indicated the usual bright bands, but they showed less shift than was the case with most Novæ The bands were less conspicuous 10 days after discovery, although the magnitude had risen from 2 4 to 2 0

COMETS —Several observations of Tempel's comet have been obtained Its magnitude is about 11, as it approaches both earth and sun during July it will steadily brighten, but this is offset by its southward motion

The following ephemeris for 0^h is by M Ebell (B Z 24)

	R A	S Decl	log r	log Δ
July 1	18^h 30^m 47^s	4° 58′	0 140	9 578
9	18 34 46	8 50	0 133	9 545
17	18 40 27	13 40	0 127	9 522
25	18 48 32	19 24	0 122	9 509

The comet is due south about 23^h It is near 2 Aquilæ on July 9 This comet has the third shortest period of any known comet Encke and Skjellerup (1922 I) come at the head of the list

Mr J Larink has deduced a new orbit of Schorr's Comet (1918 III)

$$\begin{aligned} T &= 1918 \text{ Sept } 28\ 603 \text{ G M T} \\ \omega &= 278°\ 38'\ 47'' \\ \Omega &= 118\quad 0\quad 33 \\ i &= \ \ 5\quad 35\quad 2 \\ \phi &= \ 28\quad 5\quad 1 \end{aligned}$$

Period, 6 7071 years

Mr Larink finds 1925 May 27 90 G M T (new) for the recent perihelion and gives the following search ephemeris

	R A	N Decl	log r	log Δ
July 17	5^h 12^m 48^s	19° 38′	0 274	0 418
21	5 22 54	19 51	0 276	0 416
25	5 33 0	20 1	0 278	0 413
29	5 42 54	20 9	0 280	0 411

The comet was observed in 1918 more than three months after perihelion, so its detection this year is not hopeless, though the conditions are less favourable Since it was discovered at Bergedorf, the astronomers of that observatory (to which Mr Larink belongs) are making special efforts to recover it

Research Items

STONEHENGE.—The excavations in progress at Stonehenge have now covered the greater part of the site, only the north-western area awaiting examination. The sixth report on the results, which was presented by Col. Hawley on behalf of Mr. Newall and himself at a recent meeting of the Society of Antiquaries, deals with the south and south-west area. No objects of any importance were turned up; but a number of holes, some shallow, others reaching to a depth of 28 inches and ranging in width from 15 to 23 inches, were found. These pointed to the possible existence of a stockaded passage or long roofed building at this point and it is conjectured that they were contemporary with the causeway at the main entrance, where similar post holes have been found. Nothing of the Stonehenge period had penetrated to the lower levels. Another causeway with pits in the ditch on each side of it was exposed. Seventy-one holes in all were discovered; but it is impossible to say what their use may have been, though they were too irregularly placed and too widely spaced to have formed a building. Further investigation has shown that the area of foreign stones must have held a much larger number than had hitherto been supposed, and they must have presented the appearance of a low wall. The discovery of a seventeenth-century glass flagon suggested that the removal of these stones had been comparatively recent.

UNITS OF MEASUREMENT IN ANCIENT EGYPT.—In *Ancient Egypt* for June, Sir Flinders Petrie puts forward and discusses a suggestion by Mr. J. Tarrell to account for the fact that the varying thicknesses of the courses of the great Pyramid tend to group around certain heights. The courses a dozen times or more start with a thick course, and dwindle until a thick course occurs again. An enormous number of blocks must have accumulated in the years of preparation. When the masons were ready to build, they shifted the quarrymen to another quarry and started sorting the blocks for each course according to size. This process was repeated from time to time, each thick course representing the beginning of a supply from a fresh source. The variations in thickness suggest the use of the cubit and double cubit, 20.6 and 41.2 inches, as the unit of a great number of the blocks, with a digit measure between, the groups being at 50. 40, 30, 32 (?), 34, 36, and 38 digits. Large exceptions point to local measures which may have survived into later times: 21.3 in. is the medieval Nilometer cubit; 22.2 in. the double foot of Syria found down to Roman times; 23.2 in. the double Roman foot, an ancient measure in Etruria; 26.3 in. the double of the northern foot (the foot of Germany and the basis of measurement in England which survives in the furlong and chain, and is important in France); 28 in. the Turkish *pik*; and 38.1 in. the Persian *arish*.

THE CRYSTALLINE STYLE.—Whereas in lamellibranchs a crystalline style is common, in gastropods it occurs in only a few genera. Mr. N. A. Mackintosh has given (*Quart. Journ. Micr. Science*, March 1925) a careful description of the style of Crepidula—the slipper limpet. The style, which is contained in a sac partially differentiated from the intestine is a straight transparent rod of gelatinous consistency built up of co-axial layers surrounding a spiral core. It is composed chiefly of globulin and contains an amylolytic enzyme. The style and the style-sac resemble those of lamellibranchs so closely that they must be regarded as homologous in the two groups. A list of about two dozen gastropods is given in which the style is known to occur, and it is suggested that the style has been lost in all but a few gastropods, or that its appearance in this group is to be explained on the principle of orthogenesis.

GELATION AND SOLUTION IN CELLS.—In his report (Year Book No. 23) on the work of the Department of Embryology of the Carnegie Institution of Washington located in Baltimore, Dr. G. L. Streeter refers among other items to the work of Mrs. G. M. Lewis on gelation and solution in cells. When a culture of embryonic tissue is washed with a saline solution to which any of the ordinary acids has been added to give it a P_H of 4.6, the cells undergo coagulation and exhibit appearances which are regarded as characteristic of cell death. The nucleus becomes granular and acquires a bright thick membrane; in the cytoplasm the granules cease their activity, and pseudopodia are not put out. If now, before the coagulation proceeds further, the acid solution is washed off the cells recover their normal appearance, and such a culture if returned to the incubator may live as long and remain in as good condition as the controls; in other words the gelation is reversed. Such gelation can be brought about and reversed several times in succession. The cytoplasm can be made more fluid by means of a solution of alkalies with a P_H of 8.6 to 9. The cells, instead of remaining spread out on the cover glass, begin to round off, the mitochondria change from filaments to short rods and all the granules are in dancing movement. By bathing the cultures in normal solution the process can be to some extent reversed but the cell never spreads out again, and such a culture does not live so long as the controls. One of the most effective acids in bringing about the gelation of living cells was that obtained from sterile dead tissue, and Dr. Streeter remarks that this fact should be of importance in explaining the toxic nature of crushed or burned tissue.

NUTRITION OF MYCORRHIZA PLANTS.—Dr. M. C. Rayner has published the results of further research on the nutrition of *Calluna vulgaris* (*Brit. Journ. Experimental Biol.* vol. 2, January 1925, pp. 265-292). The most striking of these is the observation of regular and well-marked digestion of the mycelial constituents in the root mycorrhiza. Digestion begins soon after the production of young roots in the spring, is carried out throughout the growing season (during which mycelial activity reaches a maximum) and continues until growth ceases in the autumn. It cannot therefore be regarded as a phenomenon of senescence. The author shows that under certain conditions the roots may be infected by the fungus but that typical mycorrhiza may not be established. By means of a special technique it is possible to find in early spring especially, the hyphæ of invading root cells undergoing digestion before branching of the filaments can take place in the cells. This formation of suppressed mycorrhiza is regarded as highly significant and is held by the author to explain the discordant results of previous workers. Assuming it to be correct "the formation of mycorrhiza is a reciprocal phenomenon involving co-operation on the part of the root cells" and "represents a temporary phase of toleration on the part of the plant cell interposed between one involving immediate destruction of an entering hypha and the wholesale digestion of the mycelium which eventually takes place." It is held, in consequence, that the obligate relation in Calluna is associated with fungal infection and seedling development rather than with the subsequent stage of typical mycorrhiza

formation The cytology of digestion, the distribution of the mycelium in the shoot, experiments with cuttings, and a general discussion on the nutritive relations in Calluna are other subjects dealt with in the paper

WATER ABSORPTION BY LEAVES —J G Wood has recently directed attention (*Australian Journal of Experimental Biology and Medical Science*, Vol 2, pp 45-56, 1925) to the remarkable capacity for water absorption possessed by the relatively uncutinised leaves of species of Atriplex These plants, the "saltbushes" of Australia, are the characteristic plants over vast areas of dry plains, and as their root system is poorly developed, this power of absorbing water by means of the leaf system may be of considerable significance It appears to be due to a remarkable accumulation of sodium chloride in the leaves of these plants Even when growing in soil containing relatively small quantities, considerable accumulation of the salt occurs in the plant As the result of microscopic examination of leaves placed in a solution of silver nitrate and then exposed to light, this accumulation seems to be most pronounced in the veins and in the chlorenchyma surrounding the veins

RADIUM ORE DEPOSITS IN CENTRAL ASIA —The presence of certain radioactive uranium minerals in Ferghana Russian Turkestan has been known since the beginning of this century The centre where such deposits have been found is the Tuya-Muyun copper mine where uranium was discovered long ago More recently that mine has been studied extensively by several Russian mineralogists geologists, and chemists and since 1923 the mine has been regularly exploited Results of the work of the expeditions recently published by the Russian Academy of Sciences show that the deposits are of great practical value as a source of radium , moreover, a study of geological conditions of the Ferghana province leads to the suggestion that radium deposits are not restricted to that mine only, but are much more widely distributed along the northern slopes of the Alai and Turkestan ranges Further investigations are being carried on by the recently founded State Radium Institute of the Academy

THE GEOLOGY OF SOMALILAND —Mr R A Farquharson's first report on the geology and mineral resources of British Somaliland, 53 pp , 1 map forms a valuable contribution to the geology of East Africa The report includes a general summary of the Somaliland sequence, which has recently been described in a monograph published by the Hunterian Museum of the University of Glasgow To the sequence already known Mr Farquharson's most important addition is that of a series of ancient unfossiliferous slates with interbedded limestones, for which he makes the interesting suggestion that they are the northern extension of the Karagwe Series of Kenya Colony and Uganda The local Jurassic rocks he attributes entirely to the Kimmeridgian , but in the absence of any information as to the fossils he collected, it remains uncertain whether this identification is likely to stand, or whether he obtained them only from the upper part of the Jurassic Mr Farquharson s conclusions as to the age of some Kainozoic rocks do not agree in some respects with those based on the collections made by Messrs Wyllie and Smellie, and an account of the author's fossils and his geological map will be awaited with interest The longer section of the report includes an account of the occurrence of numerous economic minerals, some of which are regarded as promising, though nothing has been so far proved of commercial value under present conditions In some of the specimens collected by the author, assays at the Imperial Institute record a trace of gold The report is illustrated by a map in which, unfortunately, the place names are sometimes spelt differently from those in the text The Las Khorai of the map is apparently Las Gori of the report It is regrettable that a report issued at the end of April 1925 should be dated as if published in 1924

THE PETROLOGY OF SAMOA —Prof R A Daly has written a very valuable account of the geology of Tutuila and the smaller American islands of the Samoan Group for Publication No 340 of the Carnegie Institution of Washington The average basalt of Tutuila is almost identical with that of Hawaii and with the average plateau basalt of the world This close resemblance of the oceanic and continental basalts is strongly suggestive of a nearly uniform substratum below the heterogeneous crust The alkali-trachytes and other intermediate rocks occurring in Tutuila mainly as volcanic necks and dykes, are regarded as differentiates of ordinary basalt The cause of the differentiation is, however, recognised to be still an unsolved problem, though the common eruptive sequence—basalt, trachyte basalt —found in very many volcanic centres, receives a suggestive explanation One of the domes of Tutuila is built up in part of quartz-trachyte similar to that of Ascension Island It is remarkable as one of the rare examples of a lava in the open-Pacific area containing primary quartz, and unique in being farther removed from a visible continental border than any other case yet described It suggests to Daly that the submerged edge of Australasia may really extend as far to the east as Samoa The lithification of beach sands is another problem which is fully discussed The view is adopted that the formation and distribution of the ' beach rock," as the firmly cemented sand is termed, are controlled by the action of the more violent storms These are known to pile up calcareous sands over the normal beaches, and in their new position bacterial decomposition of the organic matter associated with the displaced shelf sands tends to precipitate calcium carbonate sufficiently to fix the grains Further precipitation from the saturated tropical sea water then completes the process of cementation Ordinary clean beach sands are not cemented because they are kept in incessant movement by wave-action

THE RAYLEIGH SEISMIC WAVE —Part 5 of Vol 2 of the *Japanese Journal of Astronomy and Geophysics* contains a memoir of 93 pages by Mr H Nakano of the Central Meteorological Observatory Tokyo, on the properties of the wave propagated along the surface of the earth due to some seismic disturbance in the interior He finds that the wave does not make its appearance at the surface at a point immediately above the focus, but at distances from that point which depend on whether the originating disturbance is of the dilatational or distortional type Its amplitude when it first appears at the surface is small and it does not attain its full value until the wave has travelled a distance along the surface which is large compared with the depth of the focus The retardation of phase at each point of the surface is the same as it would be if the disturbance originated at the point on the surface over the source at the instant it actually originated at the source The author hopes by a study of the laws of propagation in a laminated earth and comparison with observations to arrive at more definite conclusions as to the structure of the interior of the earth

SURVEYS IN TIBET —In the annual reports of parties and officers, 1921–22, which is published as a supplementary volume to the general report of the Survey of India for that year, there is a brief record, accompanied by a map, of the late Sir H H Hayden's surveys in Tibet in 1922 Sir H H Hayden, who was accompanied by an Indian surveyor, travelled through the central and south-eastern parts of the country to report on certain mineral-bearing areas for the Tibetan government His routes lay between Lhasa and the great lakes of Tangra, Kyaring, Ziling, and Nam Altogether some 36,000 square miles were mapped on a quarter-inch scale, of which only some 4000 miles had been previously surveyed the remainder was known only from rough route surveys of the native Indian explorers Kishen Singh and Nain Singh, and the tracks of the few European travellers who had previously succeeded in penetrating this region

BINARY ALLOYS OF ANTIMONY AND BISMUTH —The equilibrium diagram of the binary alloys of antimony and bismuth has been already studied by several investigators The results, however, do not agree well with one another, and a re-determination of the diagram has been carried out by Otani at the Research Institute, Sendai (Report No 91) He has determined the liquidus and solidus by measurements of electrical resistance With regard to the former, he measured the difference in potential between two fixed points in the specimen, both in the liquid and solid states The current passed through the specimen for the measurement of the potential fall was 1 5 amperes, and the electrodes dipped into molten alloys were iron wires about 0 8 mm thick The rate of heating and cooling was about 1 degree per minute The liquidus curve is found to be smooth and convex upwards In the case of the determination of the solidus, the alloys were tested in the form of rods 5 mm thick and 9 cm long These rods were made by casting the alloys in an iron mould and afterwards annealing them just below their solidus for a sufficiently long period to obtain a homogeneous structure This was confirmed by microscopical examination The temperature-resistance curves obtained on heating show that the solidus also is a smooth curve, which is concave upwards The crystallisation interval in the case of the 50 50 alloy is nearly 200° C This, of course, diminishes on either side Thus the form of the liquidus and of the solidus in this system belongs to the ordinary type of solid solution where all points of the liquidus lie between those of the pure metals

THE CURRENTS IN SUPRACONDUCTORS —Supplement No 50 of Communications from the Physical Laboratory of the University of Leyden contains a report by Prof Kamerlingh Onnes of the results of the experiments on the mutual action of the electric currents in two supraconductors in the neighbourhood of each other In one case the two supraconductors are concentric rings of lead in liquid helium with their axes horizontal and the inner ring supported by a long vertical fibre provided with a torsion head The currents having been produced in the rings by the diminution of a magnetic field along their axes, the inner ring is rotated about 30° out of the plane of the outer by means of the torsion head The rotation of the inner ring is observed by means of a mirror attached to it and is found to be invariable to within less than 1 part in 1000 for 6 hours When the inner ring is replaced by a spherical shell also of lead and the experiment repeated, the torsional couple necessary to rotate the sphere is only one-third that for the ring The author concludes that the paths of the electrons amongst the molecules of matter are fixed and unaffected by any transverse magnetic field

DOMESTIC GRATES —Technological Paper No 13 of the Fuel Research Board is an account of the investigation of the relation between the design of a domestic grate and the heat radiated by it into the room, carried out by Dr Margaret Fishenden under the auspices of the Manchester Air Pollution Advisory Board The measurements show conclusively that diminution of the depth of a grate from front to back increases the heat radiated into the room per pound of coal consumed Ease of maintenance of the fire limits this diminution in most cases to a minimum of four inches The bars of the grate should be as slender as possible, and the grate should be visible from as large an area of the floor of the room as possible Conduction losses through the back of the grate should be minimised by the use of firebrick instead of iron The throat of the flue should be adjustable in area so as to permit regulation of the flow of air through the room, and an adjustable air inlet beneath the fire should be provided for the regulation of the speed of combustion of the coal

PRECIPITATION OF RADIUM SULPHATE —Sulphate ions will precipitate radium in the presence of a large excess of barium even though the solubility product of radium sulphate is not exceeded H A Doerner and W M Hoskins have investigated this phenomenon and publish their results in the Journal of the American Chemical Society for March At equilibrium, the reversible reaction

$$BaSO_4 + RaCl_2 \rightleftharpoons BaCl_2 + RaSO_4,$$

gives a distribution of radium and barium represented by the equation

$$\text{Ra (final)} \times \text{Ba (initial)} = K \times \text{Ra (initial)} \times \text{Ba (final)},$$

which is mathematically deduced from the principle that the radium-barium ratio of the precipitate (" crystal surface ") is proportional to the radium-barium ratio of the solution This equation is confirmed experimentally, K, obtained by several methods, being 1 8 The equilibrium is largely influenced by crystal growth The possible application of the theoretical equations to adsorption, fractional crystallisation, etc , is discussed

SOLID SOLUTIONS OF WATER AND OXYGEN —The attention of chemists so far has been centred chiefly on compounds subject to the law of multiple proportions, but according to N S Kurnakov (*Annales de l'Institut d'analyse physico-chimique de l'Académie de Science de Russie*, vol 2, liv 2, 1924), we must admit that this type of change is merely a particular case of a more general case—the constant change of the solid phase Attention is directed chiefly to the ferrous compounds with a variable amount of oxygen and water in such substances as mica, tourmaline, hornblende, and also phosphorus salts For these substances, the absorption of different amounts of oxygen does not affect the structure of the crystal, but creates continuous variations of colour and optical properties The greyish-black, bluish-green, and blue colour of such substances is remarkable as being doubtlessly connected with the amount of absorbed oxygen A very characteristic example is the mineral vivianite, which is a hydrated phosphorus oxide of iron, which may also be produced synthetically In the early stages of their formation the crystals are nearly colourless, but become more blue as oxygen is absorbed, without changing their structure, and remaining quite homogeneous The amount of water in vivianite crystals is also variable, the latter depends on the formation of solid solutions of water, and is very common among numerous classes of chemical compounds

The Imperial Entomological Conference

THE second Imperial Entomological Conference, which was summoned by the Secretary of State for the Colonies at the instance of the Imperial Bureau of Entomology, was held in London on June 9-18, and was attended by twenty-one delegates, representing the governments of most of the British Dominions and Colonies The delegates were received by Earl Buxton, chairman of the Committee of Management of the Bureau, at Burlington House, where the meetings were held They were also invited to a reception at the British Museum (Natural History) and to meetings of the Zoological and Linnean Societies, and were given the opportunity of visiting Oxford and Cambridge, and the Rothamsted Experiment Station and the Ministry of Agriculture s Pathological Laboratory at Harpenden

The public meetings of the Conference occupied four days, one of which was largely devoted to the general aspects of applied entomology Dr G A K Marshall, Director of the Bureau read a paper on "The Aims and Organisation of Economic Entomology" After briefly reviewing the steadily increasing importance of tropical agriculture as a source of the world s food supply and raw materials, he said that the economic effect of insect pests is not fully realised The suggestion sometimes made that crops that suffer severely from pests in a given country should be abandoned in favour of others is not feasible in the case of essential crops, and as the world s population increases, it will become more and more necessary to protect them from insect pests

The present organisation of economic entomology is unsatisfactory Economic entomology should be preventive, but a government entomologist responsible for a huge area of country, cannot hope to do more than wait to be called in by planters for advice, which only happens when an outbreak of a pest is well under way, and its control has become difficult, if not impossible What is required is that the planters should themselves employ their own entomologists, who would be continually working on the problems of their special crops, and would take steps to prevent outbreaks of pests from arising This would effect an enormous saving, and should be regarded as a form of insurance The Hawaiian Sugar Planters' Association affords an excellent example of how a scheme of this sort should be put into practice The government entomologists would then be free to undertake research

Dr T W Munro gave an account of the organisation of forest entomology in England, and in the discussion that followed, the various systems of economic entomology at home and in a number of the Dominions and Colonies were described A point strongly emphasised here and also at the other meetings was the diversity of problems presented, not only by the obvious differences of climate, crops and pests but also by the great differences in the populations concerned Thus in Egypt, where agriculture is chiefly in the hands of the illiterate classes, measures against insect pests are not only organised, but also actually carried out with excellent results compulsorily by the government, the growers paying the bulk of the cost, whereas, at the other end of the scale in South Africa all that is necessary is for one of the more progressive men in a district to be shown what to do, the others being only too glad to imitate his work

In discussing the qualifications of an economic entomologist, Mr H H King pointed out that he must not only have had the necessary scientific training, but must also have personality and a knowledge of men, so as to be able to convince those with whom he has to deal that they would benefit by carrying out the measures he suggested

Several of the meetings were devoted to pests of particular crops and other aspects of economic entomology in the various colonies, and a great deal of valuable information was interchanged, but they were, of course, of rather specialised interest Perhaps the most important discussion of the meetings, however, particularly in view of the reports of the East Africa Commission and of the League of Nations Conference on the subject (NATURE, June 27, p 985), was "Co-ordination of Effort in Tsetse-fly Investigations" The chair at this meeting was taken by Mr W Ormsby Gore, Under-Secretary of State for the Colonies In opening the discussion, Prof Warrington Yorke said that the problem is not purely entomological, but comprises four factors, namely, the trypanosomes concerned, the population and domestic stock the transmitting agent or tsetse-fly, and the reservoir of the virus, or big game An advance can only be made by taking into consideration at the same time and in the same locality all these factors In short he advocated centralisation of effort Much of the scattered work at present being carried out is failing to produce satisfactory results owing to its being misdirected, to lack of continuity and to lack of funds He thought, however, that the International Commission suggested by the Sleeping Sickness Conference that met in May under the auspices of the League of Nations was premature, and that knowledge is not yet sufficiently advanced for regulations to be formulated governing the international frontiers of tropical Africa More is to be hoped for from an inter-colonial conference, by means of which the work of entomological, medical and veterinary research could be combined under one central organisation, supported by pooled contributions of all the colonies interested

Mr C F M Swÿnnerton agreed that co-ordination between the different branches of science was very necessary, but considered that a central organisation would meet with almost insuperable difficulties He pointed out that there are twenty species of tsetse-fly, each having its own requirements in the matter of habitat and possibly fauna, and also occurring in a variety of combinations There are thus probably fifty different tsetse-problems in different parts of Africa Each colony should have its own department for the subject, touch should be maintained between the colonies by mutual visits and, if possible, by a travelling director who should go from colony to colony He described the work in Tanganyika Territory, an account of which has already been given in NATURE of March 7 p 338, and showed how co-operation has been obtained not only among the various scientific departments, but also with the natives themselves International and inter-colonial co-operation must be provided for, as the problems are often the same on different sides of political boundaries He does not consider measures against game justifiable in the present state of knowledge, and even if they proved to be so, they would be very difficult in practice He gave instances of cases in which they have actually defeated their own object

Dr A Balfour agreed with the need for inter-colonial co-operation, but considered that, as the problems in the east and west of Africa are so different, and intercommunication so difficult, it might be better to have two organisations instead of the single one suggested by Prof Yorke

Major E E Austen objected to Prof Yorke's unqualified statement that game is the reservoir of sleeping sickness He supported the idea of an International Commission, for, in the special problems to be dealt with, political boundaries are often not natural ones He emphasised the multiplicity of the problems presented by the various species of tsetse-fly and the consequent need for attacking them by every feasible method Dr A G Bagshawe pointed out that it is only within the last two years that we have been shown by Mr Swynnerton that valuable land can actually be recovered from the fly All efforts should be concentrated on making this work a success on a larger scale Dr G A K Marshall observed that trypanosomiasis has to be dealt with on two main lines the attack upon the disease, and the attack on the flies A single comprehensive investigation in one place may be excellent on the medical side, but on the entomological side there are numerous problems that can only be solved by investigations in many different localities While on the medical side further extensive research is the primary need, this is not the case on the entomological side, at least in those countries where the advance of the flies constitutes a dangerous menace Here the primary need is for an immediate direct attack upon the flies by methods similar to those so successfully employed by Mr Swynnerton, accompanied by appropriate research One great difficulty in the past has been procuring the necessary funds, and the reclamation of valuable land by a direct attack on the fly is more likely to appeal to the governments and commercial interests concerned than any programme of purely scientific research

The chairman supported the idea of an International Commission as proposed by the League of Nations Conference, not only from the scientific point of view, but also from that of educating the general public and the administrators Money is essential, and public interest must be directed to the economics of the problem From this point of view the veterinary side is of enormous importance A scheme that suggests the killing of big game when the smaller animals would remain is contrary to common sense, but a practical policy, such as that of Mr Swynnerton, should obtain public support

Before the Conference ended resolutions were passed recommending, among other things, that a similar conference should be held in London every five years, that meetings of entomologists and other scientific officers should be held in the Dominions and Colonies for the discussion of mutual problems, and that the work of the Imperial Bureau of Entomology should continue on the present lines and be somewhat extended in connexion with the export to Oversea Governments of beneficial parasites

The Conference concluded with a dinner given by the Government in honour of the delegates, at which Mr L C M S Amery, Secretary of State for the Colonies, presided

Photographic Studies of Solar Prominences [1]

THE invention of the spectroheliograph, more than thirty years ago, made it possible to study in detail photographs of the prominences, those strange and beautiful forms rising from the chromosphere which were first made familiar to readers of NATURE by the drawings of Lockyer in the 'seventies Systematic photographic work does not appear to have been initiated until it was taken up at Kodaikanal in 1905, and the Rumford spectroheliograph appears also to have begun recording prominences at about this period but until recent years very little has been published regarding their movements This is no doubt largely due to difficulties imposed by atmospheric conditions, for it is very rarely possible to secure a series of photographs of the same prominence at short intervals of time and with equally good definition in all the images In the memoir under notice this is apparent in the statement that in about 4000 plates examined "very little material suitable for the study of the motions of prominences was found" We must congratulate Mr Pettit on the very interesting results he has nevertheless extracted

The work relates very largely to the eruptive prominences, which are defined as "those which rise from the chromosphere in a more or less vertical direction, and are dissipated in space at enormous altitudes" It had already been shown by observers of eruptions that the velocity of ascent increases with the height, and photographs of prominences of this class obtained at Kodaikanal and in Kashmir appeared to show a continuously accelerating velocity, indicating a force of repulsion from the sun, analogous to that which gives an accelerating velocity to the gases in comets tails The author, however, from a careful study of the great prominence of May 29, 1919, considers that the force in this case was discontinuous, the outward velocity increasing by a series of sudden impulses, between which the motion was uniform Other prominences observed later also displayed this very remarkable characteristic and Mr Pettit was led to examine all recorded observations of eruptive prominences, visual and photographic The results are set out in 24 diagrams, giving the heights as ordinates and times as abscissæ The evidence as thus presented appears strongly favourable to the principle of uniform motion and sudden impulses for many of the diagrams indicate this very clearly, although others, *e g* No 22, would seem to indicate a continuous acceleration Of three cases which come within the knowledge of the writer of this notice, two decidedly favour continuous acceleration These are numbered 8 and 9 in Fig 3 In No 8 there is an error in the height given at 9 h, which should be 110,000 instead of 130,000 km By substituting this height in the diagram, it appears that a continuous curve would better fit the observations than that shown In the case of the prominence of May 26, 1916 (Fig 3 No 9), measures of the negatives published in Kodaikanal Observatory Bulletins III, 215 are not used in the plot, but instead a set of measures from half-tone prints Had the original measures been used a continuous curve would have resulted Evidence in favour of uniform motion is admitted in the case of No 24 which was photographed at Kodaikanal, but here the time interval is short, and no change of velocity is indicated from three observations of the height

Obviously this question of the character of the motion is of the greatest interest and significance, and it will no doubt be exhaustively studied in future eruptions

The material supplied by the Rumford spectroheliograph has enabled Mr Pettit to study successfully both lateral and internal motions of prominences Lateral motions are defined as "the motions of prominences which rise from the sun's surface, and, passing over a trajectory, generally re-enter the chromosphere" A very curious example is recorded

[1] "The Forms and Motions of the Solar Prominences By Edison Pettit Publications of the Yerkes Observatory, vol 3, part 4 University of Chicago Press

in which this trajectory appears as a circle of radius 73,500 km, and the motion along the circumference increases from 5 to 95 km./sec.

The tendency of prominences to form long horizontal streamers connecting one with another, or curving down towards the chromosphere, is familiar to all who have observed these objects. Mr. Pettit has found that motion takes place along these narrow filaments, which represent, therefore, stream-lines of luminous gas, and these lines often appear to converge towards "centres of attraction" in the chromosphere. The large prominence of May 29, 1919, afforded rich materials for a detailed study of these movements. One of the illustrations is here reproduced (Fig. 1).

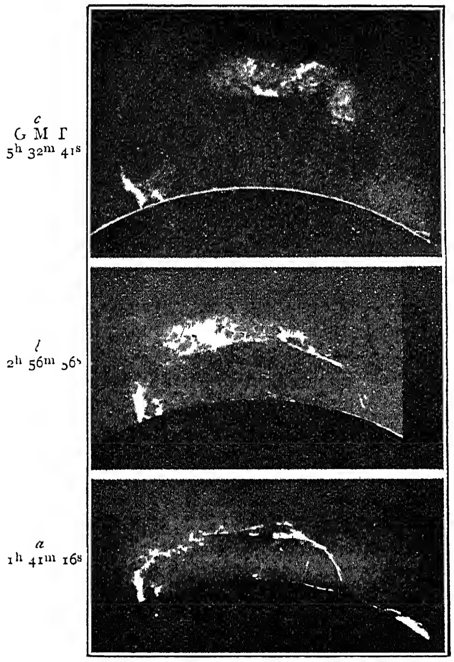

FIG. 1.—The great prominence of May 29, 1919. Scale: a, 1 mm. = 18,652 km.; b and c, 1 mm. = 16,852 km. From "The Forms and Motions of the Solar Prominences."

As regards the supposed attraction of sunspots for prominences, Mr. Pettit finds many examples of knots in streamers, or the streamers themselves moving inwards towards a spot-region, and a few in the reverse direction. Previous observations at Kodaikanal showed a predominance of outward movements.[2] That these filaments or knots actually enter the umbræ of spots remains uncertain, and no case is recorded of an entire prominence being thus swallowed up. The streamers of the great prominence of May 1919, although they converge towards a sunspot, would appear to fall short of it by about 4° of latitude (Fig. 7), and at a later stage (Fig. 8) they seem to be repelled from the spot. Other "centres of attraction" for prominence streamers are shown to exist in regions remote from spots, and there is evidence that this attraction is felt far out into the coronal region.

The question whether gravity plays a part in the descent of matter in the streamers is investigated,

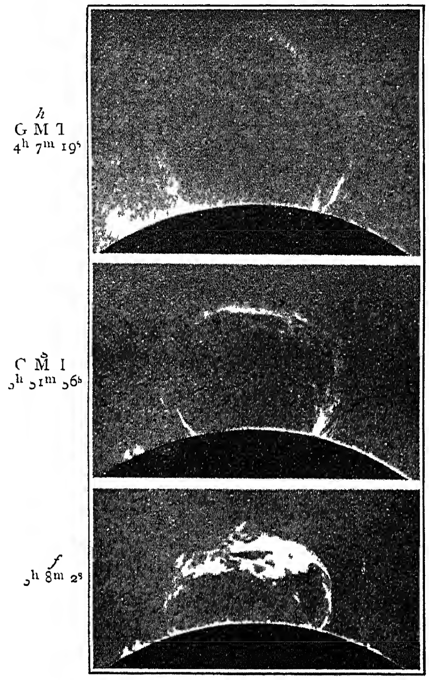

FIG. 2.—The prominence of July 15, 1919. Scale: 1 mm. = 19,144 km. From "The Forms and Motions of the Solar Prominences."

and it is found that, in general, velocities are in the neighbourhood of one-third to one-fourth of that which gravity ought to give them. The velocity of ascent in the eruptive prominences seldom exceeds 400 km./sec., although line-displacements have been recorded which indicate much higher speeds.

The memoir concludes with a theoretical discussion of the nature of the repulsive force acting on prominences. Radiation pressure is rejected as inadequate, and the periodic ejection of showers of electrons from a disturbed area in the photosphere is suggested tentatively.

J. EVERSHED.

[2] Monthly Notices of the Royal Astronomical Society, 73, 422.

Industrial Fatigue

THE fifth annual Report of the Industrial Fatigue Research Board (H.M. Stationery Office. Price 1s. 9d.) has recently been issued. Its contents are nearly equally divided between six articles contributed by the Board's principal investigators and the report proper describing the Board's activities during 1924. Perhaps the most striking development in that period has been in the direction of the increasing laboratory research work, now conducted for the Board in the Universities of Oxford, Cambridge, London, Glasgow, and Manchester, and concerned with accuracy of movement, muscular skill, repetitive work, weight-carrying, dynamic and static muscular effort, rest pauses, etc. The human factors relevant to accident causation, ventilation, illumination, and the like are also being studied. Research into vocational guidance has been undertaken in collaboration with the National Institute of Industrial Psychology, and into the design of machinery in conjunction with the Department of Scientific and Industrial Research. Three reports of specific investigations were published by the Board during 1924,

dealing with rest pauses, repetitive work and posture, and two other reports have been issued, one presenting a synopsis of the results of the Board's previous investigations in various industries, and the other describing the uses and limitations of statistical methods in such research

Those who are unacquainted with these and with the twenty-four earlier reports of the Board will obtain an excellent idea of the Board's invaluable work by a study of this annual report The special contributions by Mr Wyatt, Miss May Smith, Mr Farmer, Miss Newbold, Dr Vernon, and Mr Weston concern learning curves in industry, exceptional work curves, differential tests in relation to proneness to accidents, sickness statistics, the significance of output, and the value of personal evidence in the investigation of industrial efficiency These well illustrate the various problems and difficulties with which the Board is confronted The numerous investigations and committees of the Board, and the extremely interesting and lucid language of the annual report, bear testimony to the devotion, ability, and organising power of its secretary, Mr D R Wilson

The survey, with which the Report concludes, of the past activities and of the present position of the Board is especially noteworthy Stress is there laid on the fact that such indications "as emerge from the investigations undertaken by the Board and the National Institute of Industrial Psychology are surely worthy of serious attention on the part of industry, if only for the reason that, from the very method of their assessment, strong evidence exists that they will benefit the employer no less than the workman" It is surely lamentable, then, to read on pp 16 and 17 of the Report that the Jute Spinners and Manufacturers' Association recently declined "to participate in any inquiry or even to afford facilities for a preliminary survey" by the Board in that industry, although the Board had been expressly invited by the Jute Trade Board to undertake an investigation into the effects of fatigue and the workers desired that it should be carried out

Rothamsted Experimental Station

Opening of the Plant-Pathology Laboratories

THE annual meeting of the subscribers to the Society for extending the Rothamsted Experiments was held on Thursday, June 18, when at the invitation of Lord Clinton, chairman of the Lawes Agricultural Trust, about sixty members and visitors attended

In the morning the experimental fields were inspected As for some years past the total number of plots has exceeded 500, it is usual to select for the annual inspection a limited set illustrating one or two special points On the present occasion a series was chosen to illustrate certain contrasts between modern and early methods of planning field experiments Lawes' and Gilbert's early field experiments were laid out on the parallel strip system, the best known example being the classical Broadbalk field which has grown wheat every year since 1843 The strip system was simple and straightforward, and adequately showed up the large differences in yield between the various manurial dressings especially when the experiment was repeated over a large number of years to eliminate the variable effect of season The next stage was the "chess-board" plan in which the parallel strips of plots receiving different manures were crossed at right angles by strips of other manures This method was adopted in the Hoos field permanent barley experiments commenced in 1852, and the arrangement permits of a greater number of comparisons between given manures, alone, and in various combinations

Many of the broad generalisations, now an integral part of farming practice, were developed from the Broadbalk and Hoos experiments These two fields are still giving exceedingly valuable information, but they are not suitably arranged to provide definite answers to many modern problems, in the majority of which the maximum difference expected between control and treated plots is a few bushels of corn or hundredweights of roots It therefore becomes essential to reduce the experimental error as much as possible The first step is to have a considerable number of small plots under each treatment, and to harvest each plot separately Further, in order to allow for the inherent variation of fertility in the land, the results are examined by statistical methods devised specially for this purpose It is an essential condition of such an examination that the plots should be distributed not systematically but at random From the viewpoint of visitors this complicated system is perhaps not so striking as the older plots, but it has the great advantage of giving a reasonably accurate result in a fairly short period of time As an illustration of the method, the visitors were shown the experiments on the effect of varying the amount and time of application of nitrogenous top-dressings to the oat crop

After lunch, Lord Clinton in a short address referred to the close touch now maintained between agricultural research institutes and modern farming problems, and to the facilities for the fundamental study of plant diseases now available at Rothamsted Sir John Russell then gave a brief account of the type of problem that would be investigated in the new laboratories, and also directed attention to the economic importance of such work

Lord Bledisloe expressed his pleasure at being invited to perform the opening ceremony of the new plant-pathology laboratories, because they were erected during the period when he was chairman of the Lawes Trust In reviewing the history of the Station, he was impressed by the rapid application to farm practice of the results obtained by Lawes and Gilbert As a result the wheat production increased in twelve years from an average of 22 bushels to 32 bushels per acre He was further impressed by the loss sustained by farmers due to pests of various kinds attacking the crops Although it was not easy to arrive at an accurate estimate of such losses, the most reliable figures put it at no less than 10 per cent of the total value of crops in Great Britain It was evident that the Ministry of Agriculture, in defraying the cost of erection and equipment of the extensive new plant-pathology laboratories at Rothamsted, were alive to the importance of research work in plant diseases He had great hopes that effective preventive and remedial measures would soon be developed as a result of the facilities now provided

At the conclusion of the address Sir Thomas Middleton moved a hearty vote of thanks to Lord Bledisloe, who afterwards unlocked the door of the new building Members of the entomological and mycological departments then conducted the visitors around the laboratories In addition to a range of research laboratories, there are a number of rooms for special operations such as pure culture and constant temperature work, and a separate building fitted up for use as an insectory

University and Educational Intelligence

CAMBRIDGE —The Harkness Scholarship for geology is awarded to A J Galloway, King's College, the Frank Smart Prizes are awarded to A R Clapham, Downing College, for botany, and to G E Hutchinson Emmanuel College, for zoology, the Wiltshire Prize for geology is awarded to M Black, Trinity College

Sir David Lionel Goldsmid-Stern-Salomons, Bart, has left by his will 5000*l* to Gonville and Caius College for the fund for increasing the College buildings, and 1000*l* to augment the Salomons Engineering Scholarship Fund He has left to the University all his scientific instruments and medical apparatus, all models and human specimens suitable for instruction, his collection of crystals and other apparatus used for polariscope work The Broomhill magnet and the apparatus with it is bequeathed to the Royal Institution, London

ST ANDREWS —The honorary degree of LL D has been conferred upon Prof F G Donnan professor of inorganic and physical chemistry in the University of London, and upon Mr R T Gunther, fellow of Magdalen College Oxford

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THE Medical Research Council has awarded Rockefeller Medical Fellowships, tenable in the United States of America during the academic year 1925–1926, to the following Dr D Campbell, Pollok lecturer in pharmacology and therapeutics, University of Glasgow, Mr W H Craib, house physician, Guy's Hospital, London, Dr Katherine H Coward, assistant in biochemistry, University College, London, Mr W S Dawson, senior assistant, Maudsley Hospital London, Mr H W Florey, John Lucas Walker Student, University of Cambridge Mr A D Ritchie, lecturer in physiological chemistry, University of Manchester, Mr G P Wright, Macgregor Student and demonstrator in histology, University College, London Dr Craib, Mr Florey and Mr Ritchie have been appointed on modified conditions while holding scholarships or emoluments from other sources Mr Ritchie's fellowship is being held during a short period of work in Canada this summer

FISCAL support of State universities and State colleges is discussed in great detail in Bulletin 1924, No 28 of the United States Bureau of Education There is great variation as between the different institutions in the ratio between student fees and State appropriations In 1921 the University of Texas received eleven dollars through State appropriations for every dollar received from student fees, while at the University of Wisconsin the ratio was 2¼ to 1 The line between free public higher education and payment of part of the cost by the student has been generally lowered during the past twenty years from the beginning of the professional courses to the beginning of the undergraduate courses, and the tendency of fees for both academic and general and professional courses is to increase The writer of the bulletin assumes that the State universities will profit much from gifts of alumni for special purposes as they become older, but it does not now appear that they can hope to meet a large part of their operating expenses from endowments, the brunt of which will continue to fall on the State and the students

ERRATUM —The name P R Cuvati in the issue of June 27, p 997, col 1, line 6, should be P R Awati

Early Science at Oxford

July 6, 1686 Some of ye Society gave an account that about noon that day, they saw *Venus* near ye Moon without ye help of a Telescope, when the Sun shone very clearly, and that many people in ye streets observed ye same thing

Then was read a specimen writ by Mr John Adams (who has allready spent diverse years in a general Survey of England) concerning the *description* of particular *parishes*, who desired ye opinion and advice of ye Society what therin may be fit to pursue, what to omit of it, or what other remarks to adde

July 8, 1684 An account of ye weather at Dublin, in May last taken, in a scheme according to Dr Lister's Method, by Mr Molineux was presented by him to this Society Ordered that ye thankes of this Society be returned to Mr Molineux for this Obligation A Letter from Mr Maunders dated July 2 and giving an account of ye very great damage lately done to some parts of Somersetshire, by caterpillars, was read

An account of a monstrous child, born not long since in Jutland, with 2 draughts of that Child were presented

Two letters written, some years since, by Mr Lister, to Dr Oldenbourgh were read one concerning ye great age of severall persons in Craven, ye other concerning ye projection of ye threds of Spiders, and of bees breeding in cases made of leaves as also concerning a viviperous flye Mr Todd promises an account of ye most aged persons in Cumberland and Mr Crouch, at ye request of ye Society, engages to examine ye Register which gives an account of Mother George's age

A Paper was presented, containing ye design of some learned Gentlemen in Somersetshire to write ye naturall civil, and ecclesiasticall History of that County

July 13, 1686 In a letter to Mr President, Mr Halley promises to send an extract of ye Journal of ye Royal Society for ye time we want it, and for ye future to send us once a fortnight what shall occur there In a second letter he gives an account that ye Royal Society will allow him £50 to measure a *degree* of ye earth, and that he intends to take ye latitudes with an instrument of 20 foot radius, with telescopic sights He adds that he has seen a Calico shirt brought from India which is *woven* without a seam all of one peice

July 14, 1685 After some interruption of our meetings by reason of ye Rebellion, on this day, (Dr Smith being in ye Chair), three letters from Mr Aston were read —The ways of making Prince's metall mention'd in ye letter of July 2 were ordered to be tryed, which Mr Ballard undertook to do

Mr St George Ash, Secretary of the Dublin Society, sent ye Minutes of that Society for ye month of June together with a paper enclosed in it, drawn up by Mr Smith Fellow of Trinity College, by way of answer to Mr Molyneux's Quæries concerning Lough-Neagh, which paper with very good reason ascribes a petrifying quality to ye Earth but not to ye Water of that Lough The thankes of this Society were ordered to Mr Ash and Mr Smith for these communications — Mr Aland's discourse concerning ye longitude, and an account of ye monstrous fish mentioned in ye Dublin Minutes, are desired to be sent us

Dr Cony presented ye Society with a telescope in ye name of Thomas Hardresse of Rochester Esqr Ordered that ye Secretary send ye most humble thankes of this Society to Mr Hardresse for this very generous present, and that it be carefully preserved in their Repository

Societies and Academies.

London

Royal Society, June 25 —D H **Black** β ray spectra of thorium disintegration products Using comparatively strong sources of thorium-B in equilibrium with thorium-C and thorium-D, the β ray spectra of these substances have been re-measured in order to bring them into line with the standard spectrum of radium-B Several new lines were found Of these, one group is of great interest on account of the fact that, despite their high energy (2 5 million volts), they are due to the expulsion of electrons from the *K*, *L*, and *M* levels of an atom by one γ ray —C F **Elam** Tensile tests of crystals of an aluminium zinc alloy The crystals, containing 18 6 per cent zinc, resemble pure aluminium in structure and contain the zinc in ' solid solution " They are harder and less ductile than pure aluminium Fracture occurs on one or more planes at approximately 45° to the axis These planes are closely related to crystallographic planes Slip planes are sometimes parallel to planes of fracture —G **Shearer** On the distribution of intensity in the X-ray spectra of certain long-chain organic compounds In the X-ray " spectra " of substances the molecules of which contain long open chains of carbon atoms, there is a certain large spacing corresponding to planes at distances apart closely related to the length of a single molecule or of two, end to end A large number of successive orders of reflection from this plane can be observed, and their distribution of intensity is calculated on certain simple assumptions as to the distribution of scattering material along the length of the molecule It is thus possible to fix with reasonable accuracy the position in the chain of the CO group in such series as the ketones and the esters, this appears to open up a new application of X-ray methods to chemical analysis Further work on these lines may throw light on the relative scattering power of the various atoms and atomic groups —C F **Jenkin** High-frequency fatigue tests High-frequency fatigue tests on copper, Armco iron, and mild steel were obtained at frequencies so high as 2000 periods per second, and unsuccessful experiments were made up to 5000 periods per second There is a small rise in the fatigue limit as the speed is increased The dependence of the fatigue limit on the frequency has however, an important bearing on the theory of fatigue failure The term ' fatigue limit " is used here to denote the greatest alternating stress which can be applied to a material for an indefinitely large number of periods without causing fracture —L W **Bryant** and D H **Williams** An investigation of the flow of air around an aerofoil of infinite span The stream-lines deduced were compared with those for inviscid flow obtained by means of an electric tank in which the equipotential lines were equivalent to stream-lines in a perfect fluid Except for a narrow trailing " wake," the lines of viscous flow approximate to those for an inviscid fluid, when a circulation equal to that experimentally determined in the wind tunnel is superposed upon the flow around the aerofoil without circulation The boundary layer around the nose and over the under surface of the aerofoil is very thin Velocities deduced from observed pressures on the surface agree very well with velocities measured in the free stream, except over the upper surface, where " wake " begins to develop —G I **Taylor** Note on the connexion between the lift of an aerofoil in a wind and the circulation round it (Appendix to preceding paper) The connexion between the lift force on an aerofoil and the circulation round it is independent of the contour chosen if the flow is irrotational, and also if the flow is not irrotational provided that a special type of contour is used, according to Messrs Bryant and Williams Their contours happen to be of the special type, so the accuracy with which the observed lift force agrees with that predicted from measurements of circulation is no indication that the flow is in fact an irrotational motion with circulation —T H **Havelock** Wave resistance the effect of varying draught The effect of finite draught is considered, in particular, calculations are made when the ratio of draught to length is one-twentieth and one-tenth, a range which covers approximately ship models The theoretical curves show a reasonable agreement with experimental results —C V **Raman** and L A **Ramdas** The scattering of light by liquid boundaries and its relation to surface tension Part III —W H **George** An electrical method for the study of impact applied to the struck string The two impinging bodies close, during the impact, a simple electrical circuit which includes an oscillograph From the current variations shown in the oscillograph record, the variations in mechanical pressure during the impact is derived With a struck string there are important fluctuations in the pressure between the hammer and string, depending markedly upon the position of the striking point along the string At some places there is a momentary complete separation of hammer and string These results are inconsistent with the older theories of the struck string, but are consistent with the newer theories The ballistic galvanometer method to determine the duration of the impact upon the struck string is in general, invalid —F H **Constable** The mechanism of catalytic decomposition A quantitative theory based upon the series of papers entitled " The Catalytic Action of Copper " (Proc Roy Soc, A, vols 98 to 107) is developed The dehydrogenation of alcoholic substances by copper occurs in stages Reaction only occurs in a unimolecular layer in which the $-CH_2OH$ groups are in contact with the copper surface Activation of the alcohol molecule by the catalyst consists in increasing the distance between the H atom and the O atom in the hydroxyl group Quantitative treatment from this point of view leads to results which are not in accord with experiment Application of the theory of probability to the conception of a " reaction centre enables the number of centres present to be connected with the heat of activation of each by an exponential relation The equation obtained is in accord with experience in so far as it can be tested —S A **Emerson** and L C **Martin** The photometric matching field —II Peripheral stimulation of the retina with white light may cause a reduction in the limen of contrast perception at the fovea With monochromatic lights, using the same wave-length in centre and surround, initial reductions followed by a rise in the limen are found with increasing brightness of surround at all wave-lengths, but the reductions are small in the red as compared with the blue end of the spectrum The effects may be partly due to reflex actions associated with the retinal rods —G S **Adair** Partial osmotic pressures and membrane equilibria Methods for calculating partial pressures are described, based on a long unrecognised equation for membrane equilibrium, developed by Gibbs The modified form of Dalton's law applies to certain hæmoglobin solutions over a wide range of concentrations, not necessarily restricted to the very short range where the pressure is proportional to the concentration The partial

osmotic pressure of hæmoglobin is related to the concentration by a form of Van der Waals' equation —Mary W **Porter** A contribution to the study of the optical properties of mixed crystals In mixtures of ammonium- and rubidium-magnesium chromates (1) Variation of principal refractive index for vibrations along the symmetry axis is directly proportional to composition as expressed in volume or molecular percentage (2) The other two principal indices are also continuous functions of the composition, but are not directly proportional The general result extends the work of Lavenir and Dufet on orthorhombic mixtures —H **Gregory** and C T **Archer** Experimental determination of the thermal conductivities of gases —D B **Deodhar** On atmospheric radio-activity and Indian weather —J R **Partington** and A B **Howe** The ratio of the specific heats of hydrogen The determination of the ratio of the specific heats of hydrogen was undertaken by a method of adiabatic expansion previously used with air and carbon dioxide The mean of nine determinations with pure hydrogen at atmospheric pressure and temperature gave $\gamma = C_p/C_v = 1\ 4113$ and the values of C_v (4 832 gm cal) and C_p (6 820 gm cal) were calculated from this value and $C_p - C_v = 1\ 9875$ —A **Cary** and E K **Rideal** The behaviour of crystals and lenses of fats on the surface of water —Part I In the process of ' surface spreading ' on water and solutions of N/100 hydrochloric acid of organic compounds containing a long chain terminating in a polar group unimolecular films spread from crystals as well as lenses, a definite equilibrium surface tension or two-dimensional pressure, characteristic of the compound in question, being established Spreading oil films appear to be pushed out from the source (lens or crystal) by the further entry of molecules into the surface layer, rather than pulled out over a surface by the attraction of the uncontaminated water —G H **Henderson** The capture and loss of electrons by α particles Singly charged α particles were measured by an ionisation method The ratio of doubly charged to singly charged particles in equilibrium is the same in different materials, such as gold, mica aluminium etc With this ratio for any material expressed as the nth power of the velocity, the value of n increased as the velocity decreased —A S **Parkes** The effects on fertility and the sex-ratio of sub-sterility exposures to X-rays —R N **Chrystal** The genus Dreyfusia (order Hemiptera family Chermesidæ) in Britain and its relation to the silver fir —T **Moran** The effect of low temperatures on hens' eggs —T C **Angus** The electrical characteristics of an arc lamp (direct current) measured by biological effect —R J **Lythgoe** and J R **Pereira** Muscular exercise, lactic acid and the supply and utilisation of oxygen —Part XI Pulse rate and oxygen intake during the early stages of recovery from severe exercise —J R **Pereira** Muscular exercise, lactic acid, and the supply and utilisation of oxygen —Part XII A note on the technique of determining the resting oxygen intake while breathing concentrated oxygen mixtures —Mary E **Laing** The composition of soap films —G R **Goldsbrough** Torsional vibrations in reciprocating engine shafts —D **Brunt** Periodicities in European weather —S **Barratt** The absorption spectra of mixed metallic vapours (II) —S R **Savur** On the stress-optical effect in permanently overstrained celluloid —O W **Richardson** Structure in the secondary hydrogen spectrum (II) —A **Cary** and E K **Rideal** The behaviour of crystals and lenses of fats on the surface of water (II and III) —J E **Jones** and P A **Taylor** Some theoretical calculations of the physical properties of certain crystals —C **Chree** The relationship between the " solar constant " and terrestrial magnetism —J A **Carroll** The vacuum spark spectra of some of the heavier elements and series classification in the spectra of ionised atoms homologous with copper silver, and gold —Sir J C **Bose** Physiological and anatomical investigation of *Mimosa pudica* —J F **Fulton** Fatigue and plurisegmental innervation of individual muscle fibres —G **Matthai** Colony formation in astræid corals (I)

Royal Anthropological Institute, May 19 —R Ruggles **Gates** Mendelian inheritance in man Many abnormalities in man are inherited as simple Mendelian differences, and this is to be expected since they must have arisen as single mutations Such are brachydactyly and many other digital abnormalities, which are usually inherited as dominant characters There is evidence that even slight abnormalities may sometimes be lethal in their effects when present in the homozygous condition Cataract is usually inherited as a dominant, while such conditions as albinism and alkaptonuria are recessives Colour-blindness hæmophilia and some other conditions are usually sex-linked in inheritance, their history following exactly the course from generation to generation taken by the sex chromosomes But various exceptions are found and the same character may be differently inherited in different families according to which part of the germ plasm was originally altered The cephalic index has long been regarded as an important racial character Recent investigations of Frets, Hilden and others lead to the view that multiple, cumulative size factors are involved and that brachycephaly in general is dominant over dolichocephaly Age, sex nutrition, stature and climate affect the head form Interracial crosses appear frequently to give 2-peaked curves for cephalic index in later generations Records of crosses between Indians and whites, obtained in Northern Ontario, indicate that skin-colour segregates and that eye-colour is inherited independently of skin-colour

PARIS

Academy of Sciences, June 2 —A **Haller** and F **Salmon-Legagneur** The action of methyl magnesium iodide on the esters of the α-mononitrile of camphoric acid When the reaction takes place in ethereal solution the corresponding tertiary alcohol is produced in toluene solution the nitrile group also takes part in the reaction, a ketone-alcohol being produced —H **Vincent** The plurality of the toxins of the coli bacillus and the experimental bases of anticolibacillus serotherapy Evidence is given of the existence of toxins of *B coli communis* differing in their thermostability and action on animals —de **Sparre** The velocity of propagation of the ram stroke in armoured concrete mains —Ame **Pictet**, Werner **Scherrer** and Louis **Helfer** The presence of argon in the gases from the alcoholic fermentation of glucose Observations are given showing that in the alcohol fermentation of glucose, argon is evolved It remains to be proved if this gas pre-exists in the yeast and in what form —C **Sauvageau** The development of *Leathesia difformis* —Benjamin **Jekhowsky** The generalisation of Cauchy's numbers —Stefan **Banach** A characteristic property of orthogonal functions —P J **Myrberg** Discontinuous groups of linear substitutions —C **Deve** An apparatus for microscopic reduction entitled " Pangraphic " A description of a simplified pantograph, without articulation —Bernard **Lyot** Variations of the polarisation of Mars in the course of an

atmospheric disturbance —Jean **Boccardi** The rotation of the interior planets —H **Noirel** Determinations of the intensity of gravity made in the Republic of Ecuador during the expedition of the Service geographique de l'Armee (1899–1906) —Mlle E **Gleditsch** and E **Botolfsen** The X-ray spectrum of praseodymium, neodidymium, and samarium Tables are given showing the wave-lengths of seven lines for each metal —J **Heyrovsky** The physical signification of electrolytic solution pressure —Eugene **Delauney** A new method of quantitative analysis by X-rays Various elements absorb a monochromatic bundle of X-rays to different extents Details of the application of the method to solutions of barium and strontium chlorides, and of potassium chloride and bromide, are given —J L **Costa** The precise determination of the atomic mass of lithium 6 by Aston's method Taking He =4 000, the mass of the lithium (6) atom was found to be 6 010± 002 —Rene **Audubert** and Henri **Rabate** A method of determination of the granulometric distribution of dispersed systems —Ch **Courtot** and R **Geoffroy** 2 7 9 9′-tetrahydroxy-fluorene —R **Lautz** and A **Wahl** The arylaminonaphthoquinones The arylaminooxynaphthalene sulphonic acids —L **Cayeux** The existence of diatomaceous silex in the flints of the coarse limestone in the neighbourhood of Paris The silex consists of petrified organic residues Remains of foraminiferæ radiolaria, ostracods, and gasteropods were found —J **Orcel** A white chlorite from Madagascar —Fernandez **Navarro** The meteorite of Olivenza (Spain) This was seen to fall on June 19, 1924 The predominant mineral is olivine, but the meteorite is remarkable for the small proportion of nickel-iron —Jacques de **Lapparent** The two forms of hydrocarbons in bituminous schists —H **Bouygues** The axillo-cotyledon facies of the Soissons bean —Alfred **Labriet** and Raoul **Husson** The principle of vocal accord, or a contribution to the elaboration of a theory of the normal emission of the singing voice, and the synthesis of the corresponding vocal mechanism —P **Maze** The influence of fluorine and iodine on the reproductive functions in rats and on the growth of the young Experiments on the necessity of the presence of fluorine in the diet of rats to ensure reproduction —T **Kahn** Active protoplasmic mass and reserve albumen —Ch **Richet**, jr and R **Monceaux** Modifications caused by cooking in the metabolism of meat From experiments on dogs it is concluded that the metabolism of raw meat is more perfect than that of cooked meat In diseases of the liver it is advantageous to administer raw meat in renal affections, however, well-cooked meat is indicated —J **Benoit** Compensating hypertrophy after unilateral castration in the domestic cock —E **Faure-Fremiet** and J **Murakami** The amæbocytes of the earth worm in the quiescent and in the active state —H **Herissey** Asperuloside, a new glucoside extracted from the wood-ruff The new glucoside has been prepared in crystals, contains no nitrogen, and gives on hydrolysis a reducing sugar and asperuligenol —Alphonse **Labbe** Four generations of *Artemia arietina*,—MM **Mouriquand, Leulier, Michel,** and **Idrac** C avitaminosis and cholesterinæmia —Raoul **Bayeux** Structural modifications of the lung under the influence of great barometric decompressions The essential primitive lesion of the lung determined by a sudden fall in the atmospheric pressure is the parietal hypertrophy of the alveolæ, all the cardio-vascular phenomena are secondary to this initial lesion —F **Henrijean** The signification of the electro-cardiogram

Official Publications Received

Falmouth Observatory Meteorological Notes and Tables for the Year 1924 By Joshua Bath Phillips Pp 10 (Falmouth)

The University of Leeds Department of Coal Gas and Fuel Industries (with Metallurgy) Report of the Livesey Professor for the Session 1923–1924 Pp 11 (Leeds)

Mitteilungen der Naturforschenden Gesellschaft in Bern Aus dem Jahre 1923 Pp lxxviii+195 Aus dem Jahre 1924 Pp lxii+156 (Bern K J Wyss Erben)

Proceedings of the Edinburgh Mathematical Society Vol 43 (Session 1924–25) Part 1 Edited by Dr T M MacRobert and Prof H W Turnbull Pp iii+84 (London G Bell and Sons, Ltd) 5s net

Diary of Societies

SATURDAY, JULY 4

INTERNATIONAL CONGRESS OF RADIOLOGY (at Central Hall, Westminster), at 10 A M

BRITISH MYCOLOGICAL SOCIETY (Phytopathological Excursion to Cambridge) —Prof Sir R H Biffen and F L Engledow The Inheritance of Disease Resistance —F T Brooks and W C Moore Silver leaf Disease —N J G Smith Helminthosporium Disease of Cereals —D Weston The Control of Bunt in Wheat —R C Woodward Apple Mildew —Mrs M N Kidd Fungal Invasion in Apples in Relation to Senescence —S M Wadham Clover Rot —A Smith Perennial Rust Mycelia —Prof Nuttall, Dr Hare, and Mr Tait Fungi Pathogenic to Man

PHYSICAL SOCIETY OF LONDON (at Oxford)

PHYSIOLOGICAL SOCIETY (at Oxford)

MONDAY, JULY 6

ROYAL SOCIETY OF EDINBURGH, at 4 30 —G L Purser The Alimentary and Respiratory Systems of *Calamoichthys calabaricus* Smith —W J M Menzies Salmon (*Salmo salar*) of the River Moisie Eastern Canada —Dr W W Taylor Precipitation of Sols by Polyvalent Ions —J A Warren and W A Tait Analysis of Rainfall Records in Glendevon Catchment Area during the years 1914–1920 —Prof A A Lawson A Contribution to the Life History of Bowenia —Dr E Neaverson Ammonites from the Upper Kimmeridge Clay

ROYAL INSTITUTION OF GREAT BRITAIN, at 5 —General Meeting

FARADAY SOCIETY (Annual General Meeting) (at Chemical Society), at 5 15 —At 5 30 —A L Marshall The Electrodeposition of Zinc from Acid Zinc Sulphate Solutions —F L Usher The Nature of the Interfacial Layer between an Aqueous and a Non Aqueous Phase —J B O Sullivan The Application of the Quinhydrone Electrode to the Measurement of P_H Values in Solutions containing Copper Ions and other Divalent Ions —J A V Butler Co ordination and Valency —E D Campbell A Chemical Theory of Remanent Magnetism

ARISTOTELIAN SOCIETY (at University of London Club, Gower Street), at 8 —Miss L S Stebbing Logical Categories

MEDICO PSYCHOLOGICAL ASSOCIATION OF GREAT BRITAIN AND IRELAND (at Birmingham University)

TUESDAY, JULY 7

MEDICO PSYCHOLOGICAL ASSOCIATION OF GREAT BRITAIN AND IRELAND (at Birmingham University) —Sir Frederick Mott Presidential Address

INSTITUTION OF MECHANICAL ENGINEERS (Summer Meeting) (at Newcastle upon Tyne) (Continued on July 8, 9, 10)

WEDNESDAY, JULY 8

MEDICO PSYCHOLOGICAL ASSOCIATION OF GREAT BRITAIN AND IRELAND (at Birmingham University) —Dr G A Auden Encephalitis Lethargica and its Psychological Implications

THURSDAY, JULY 9

DIESEL ENGINE USERS ASSOCIATION (at Town Hall Maidenhead) at 3 —C O Milton The Working of the Ruston Mechanical Injection Engine

TUBERCULOSIS SOCIETY OF SCOTLAND (at 6 Drumsheugh Gardens, Edinburgh) at 4 30 —Prof H Moellgaard and Prof K Faber The Sanocrysin (gold) Treatment of Tuberculosis

MEDICO PSYCHOLOGICAL ASSOCIATION OF GREAT BRITAIN AND IRELAND (at Birmingham University) —Dr Graves Incidence of Chronic Sepsis in Mental Disease —Dr Pickworth The Iodine Content of Thyroid Glands

FRIDAY JULY 10

MEDICO PSYCHOLOGICAL ASSOCIATION OF GREAT BRITAIN AND IRELAND (at Birmingham University) —Dr A M McCutcheon The Institutional Treatment of Mental Deficiency —Dr W A Potts Delinquency —Dr H Smith The Psychopathic Personality

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Science in Boys' Schools The Administrative Aspect[1]

THE issue by the Board of Education of the pamphlet before us is opportune, having regard to the development of secondary schools now being taken in hand The report expresses the views of five of H M Inspectors and deals more particularly with observations in 39 boys' schools, mostly urban As a rule, the schools contained more than 400 pupils and had Advanced Courses, high value is rightly attributed to the institution of these courses, which have brought about improvements in apparatus and equipment—including libraries—and, best of all, secured more highly qualified teachers Throughout the report, references appear to the primary need for securing teachers of sufficiently wide knowledge, breadth of interest, and business capacity in management of the science side of a school in all its details, financial and technical as well as professional The science master must be competent to design and revise syllabuses, to draft requisitions, to organise the economical use and repair of apparatus It is suggested that university training departments should teach laboratory management, the need of which is even greater among science mistresses than with men

The whole report is evidently the result of careful, fair-minded observation, and if the constructive suggestions are too restrained, there are fairly plain hints to any science master who looks for guidance He is urged to aim at a really good standard of equipment, and school authorities are advised to provide for the gradual carrying out of well-planned schemes extending over a few years There is no doubt that much can be done thus, particularly with subjects like electricity and optics where the apparatus is practically permanent

The neglect of biological studies, and the narrowness of the syllabuses, are attributed to the over-specialisation which the universities require in candidates for degrees At Cambridge and London, mathematics, physics and chemistry suffice for the preliminary years of the degree course Boys who are not introduced to biology before leaving school seldom take up such study later—"in this matter we are in a vicious circle" It may be pointed out, however, that some alert headmasters of the larger Public Schools are developing biological classes, securing thereby an infusion of valuable thinking into the higher forms and an avenue to open scholarships which is not at all crowded at present More than this is needed to cure the too urbanised outlook of our boys, but perhaps there is better hope for biology introduced from above to supply the sixth form "specialist" than from the

[1] Report of an Enquiry into the Conditions affecting the Teaching of Science in Secondary Schools for Boys in England Pp 28 (London. H M Stationery Office, 1925) 3*d* net

nature study of the preparatory school One wonders what would have happened if biology had changed places with engineering in the growth of Oundle School

Another weakness in the present administration is the inadequacy of the provision of laboratory attendants This is bad economy An example is given of a very efficient school in which the laboratories are economically run, that is, with wise expenditure and without waste The cost of apparatus and materials is 9*s* per head and of wages 7*s* 6*d* per head, which is about one-third of the corresponding figures for the larger public schools It would have been worth while to point out that to leave an unskilled youth to clean up is to expose a laboratory to risk of destruction by fire

In view of the number of new schools now being planned, it is to be hoped that the Board of Education will issue some suggestions on the planning of general and advanced laboratories for boys and girls respectively It is extremely difficult to alter a block of science buildings, and too many laboratories are built on a wrong assumption as to the number of pupils to be taught as a class More and more pressure to reduce the staffing ratio will come, partly as the result of Burnham scales, and the Board of Education will be compelled to face the problem of the desirable size of classes in practical work

In connexion with the Burnham Scales, it is unfortunate that the Board of Education refuses to recognise works experience as qualifying in any way for service increments Two examples come to mind, both of university graduates, where recognition was granted by the local education authority and refused by the Board of Education One of these had first-rate works experience and has designed and made, with the aid of his boys, most of the really good equipment for teaching mechanics and electricity in his school The other had experience as assistant in the Cavendish Laboratory which has been of immense help to his teaching Both men have now to accept lower salaries than if they had become teachers without such experience Not all works experience is valuable, but it is sheer folly to put obstacles to teaching in secondary schools in the way of such men as those to whom we have referred It is to be hoped that the new award will leave appointing authorities some discretionary power of recognition of such experience in instrument-making as calls for the study of scientific principles and the acquisition of manipulative skill

In their concluding observations the inspectors return to the first essential—the quality of the teacher Quite rightly, credit is given to the Science Masters' Association and the *School Science Review* for the useful work done in promoting discussion and interchange of opinion among teachers A science teacher and inspector of long experience wrote recently to express his "deep indebtedness to NATURE for invaluable help during all my teaching career, especially during the years when I was almost cut off from science workers except for the holidays when the British Association brought the needed companionship of fellow-workers" Without insisting on any particular journal, it may be regarded as a bad sign if a science master is neglecting current scientific literature The short courses arranged for vacations by the Board of Education are excellent, and they are widely appreciated Why are half the applications refused? If the Board is unwilling to spend the money, this is another bad economy But considering the pressure in the opposite direction, it is perhaps fairer to thank the Board for all it is doing, especially the successful attention by which the courses are made of such direct value in the school-teaching of science We are grateful for this Report, which we hope will be studied in detail by headmasters as well as science masters, and also by the administrative side of the Board

The Unity of Social Science

The Earth before History Man's Origin and the Origin of Life By Edmond Perrier Pp xxiv + 345 15*s* net

Prehistoric Man a General Outline of Prehistory By Jacques de Morgan Pp xxiii + 304 12*s* 6*d* net

Social Organisation By Dr W H R Rivers Edited by W J Perry Pp xi + 226 10*s* 6*d* net

Language a Linguistic Introduction to History By Prof J Vendryes Translated by Dr Paul Radin Pp xxx + 378 16*s* net

History and Literature of Christianity from Tertullian to Boethius By Prof Pierre de Labriolle Translated from the French by Herbert Wilson Pp xxiii + 555 25*s* net

The Threshold of the Pacific an Account of the Social Organisation, Magic and Religion of the People of San Cristoval in the Solomon Islands By Dr C E Fox Pp xvi + 379 + 14 plates 18*s* net

The History of Civilisation Series (London: Kegan Paul and Co, Ltd, New York Alfred A. Knopf, Inc, 1924–1925)

SOCIAL and cultural scholarship, or as we call it in its beginnings, humanism, was, in the development of modern European thought, born before natural science But it has been badly out-distanced by its younger sister, and only of late can it be seen emerging out of disorganisation and chaos Nor is the road quite clear yet Is there any unity in the vast medley of "histories" and "philosophies" whether of language or of literature, of art or of political institutions, of

economics or of morals, of law or of religion? In what relation do they stand to the old-fashioned history, pure and simple? Is *sociology* merely a new name for these studies taken in bulk, or does it stand for an attempt at unification in method, aim, and the adjustment of tasks?

To these questions, and to many other detailed ones, there is no answer yet on which all can be agreed, though philosophers and methodologists have been busy discussing them for some time, especially in Germany. There is, however, a marked tendency at present among the specialists as well as among those who survey matters from epistemological points of vantage to come into touch with each other, to recognise the unity of social science and to co-ordinate their work so as to avoid unnecessary duplication, to eliminate unhealthy specialism, and to foster the sole aim of humanism—the knowledge of man's nature, of his social organisation and of his culture.

The History of Civilisation Series, some volumes of which form the subject of this notice, promises to be perhaps the most important contribution so far undertaken towards the task of organisation and systematisation of the social studies. A glance at the prospectus makes us anticipate a library of masterpieces, for the best workers of France, Great Britain and some other countries are contributing from their own speciality and are attempting to bring it into line with the contributions from neighbouring fields and with the results of general sociology. Including all the volumes of the important French collection "L'Evolution de l'humanite," started a year or two ago and now in progress, the English Library, edited by Mr. C. K. Ogden, of Magdalene College, Cambridge, contains additions and improvements which will place it, no doubt, above its continental counterpart. The volumes already issued in English fully bear out our best hopes, and those additions which do not belong to the French series, the volumes by Dr. Rivers and Dr. Fox, establish its claim to superiority.

The whole plan of the English series is in itself a vindication of the unity of social science. Arranged so as to include all manifestations of human culture accessible to the eye of science, it follows roughly a combined historical and geographical plan. Starting from the most comprehensive picture, the empty earth in the midst of the empty universe awaiting the arrival of man, it passes then to the gradual development of organic life and the early history of mankind. These initial stages, described in the volumes of MM. Perrier and de Morgan, are accompanied by a series of introductory works which give a theoretical account of the various aspects of human culture: social organisation (by Dr. Rivers) and language (by Prof. Vendryes), the two tools of human action and of human thought; the geographical and the racial factors (in two volumes by MM. Febvre and Pittard); an epitome of man's political evolution (in the book of MM. Morel and Davy, "From Tribe to Empire"), a volume on man's primeval domesticity ("Woman's Place in Simple Societies," by Prof. J. L. Myres), and "Cycles in History" by the same writer.

The story then begins at the traditional cradle of culture, the ancient East, on the holy banks of the Nile, the Euphrates and Tigris, and on the shores of the Mediterranean, where the origins and history of the early Empires and their civilisations are described. Remaining within this geographical area, we follow the lead of time, and after having been shown the growth of the Ægean civilisation and the formation of the Greek people, we study the history of Greece in all its wonderful cultural achievements; next, in obedience to historical destinies, hegemony has to be surrendered to Rome, with the laws, politics and economic organisation of which we are then concerned, from the humble republican beginnings to the final expansion of the Empire. This brings us far beyond the geographical boundaries of the Mediterranean basin to the vast areas occupied by the Teutonic peoples to the north, the Persian, Indian and Chinese civilisation to the east, and the Mongol cultures of Central Asia. All these cultures will be studied in a series of monographs in a special section which closes the big division devoted to pre-history and antiquity. The second division will contain volumes on Christian religion, on the break-up of the Roman Empire, on the religious imperialisms of Christianity and Islam, on the political, social, economic and intellectual evolution in the Middle Ages and modern times. The English library contains besides all this several special sections, one on the histories of various subjects, such as medicine, money, costume, witchcraft and what-not; a section on Oriental culture, on historical ethnology, and a few more special sections not yet exhaustively announced, dealing with modern history.

The field of social science is thus fully and comprehensively covered in the English library. But this summary following merely geographical and chronological lines does not do full justice to the merits of the plan and of the achievements of the series, so far as they have been laid before us. It is the nature of the subjects treated in each group which constitutes its importance and makes it absolutely unique, as the first fully scientific history of civilisation in the English language. For there is no doubt that a deep modification in our conception of history has taken place during the last generation or so.

Take, for example, the history of Greece or Rome:

For most of us it has been, and still remains, the kernel of historical reality and the standard of our cultural values. Ancient Greece especially embodies for us the retrospective ideal of heroism, beauty and wisdom shining in the glory of a unique setting, of a chosen people and of an irrevocable past. We have our Golden Age in this myth of Greek culture, of Roman statesmanship, and this myth has been one of the main civilising forces from the Renaissance up to the present day. However science might deal with this mythology, scholars, dreamers and metaphysicians will still read into certain epochs of history an inspiring epic, a thrilling drama, a revelation of purpose and wisdom in destiny, a moral inspiration which allows man to bear the gloom and oppression of his own time. The reality of Homeric fights, of the Biblical stories and the myth of classical antiquity, will remain untouched for ever by the most destructive of "higher criticisms."

This is well, for we want our myth to remain intact, while at the same time the spirit of science forces history into accomplishing a different task from that of glorifying and idealising the past or of making it into a dramatic play of national destinies. The new history cannot carry out its work without the help of social science, psychology and a comparative study of culture. Scientific history, after it has thrown overboard drama, sentiment and myth, after it has introduced the most rigorous methods of scrutinising and reconstructing sources, still stands helpless before its main task: and that is to build up the process of human development in terms of personality and character as they work upon masses of people and as they solve questions of organisation and politics, of taxation and other economic arrangements, of warfare and education, of domestic, moral and religious institutions. For the knowledge of personality and character the historian might repair to the psychologist; in the study of organisation and politics the sociologist might help him; the scrutiny of values, whether material or moral, has to be carried on in collaboration with economics, the science of material culture, ethics and other normative disciplines.

Yet in all this the historian will find that he has quite as much to give as to take, for each of his auxiliary sciences has suffered by conducting its work single-handed and upon a somewhat artificially specialised material. The student of psychology has worked on an isolated, individual mind, suspended *in vacuo*, and he has wasted much of his time therefore in studying an unreal figment. Endless "sociologies" have been written upon a subject constructed *ad hoc*, whether it be the "group mind" or the "consciousness of kind," "imitation" or "race war" conceived as unique sociological principles, the "purely formal" in human organisation or the "exclusively organic." Economists have created another figment for science in the mathematically economic man who follows the purely economic motive. The moralist made his "absolute good," his "categorical imperative" or his "moral sense," and proceeded forthwith to study and to worship the idol fashioned by his own hands. Each specialist foredoomed his results by working on a figment. For human nature cannot be cut up into bits, nor man's mental endowment separated from his social habits or his material culture, or his moral and economic values. The human mind, with its plastic instincts shaped into cultural habits, its reason bound up with language and its emotional life determined by social bonds, values and ideals, is an integral subject of study. Specialisation there must be, and it probably will have to run on the traditional lines of psychology, sociology, economics, ethics and so on. But this specialisation must be the result of a central theory of human culture, this term of course embracing the human mind, the factors of organisation and material civilisation.

In this the historian, coming with his concrete, full-blooded reality of an individual civilisation at a definite epoch evolved by a definite race, forces the specialists to face the real problem. For in the concrete reality of life, regarded comprehensively and examined scientifically, we see how all the aspects intermingle and influence one another,—each sufficiently independent to require a specialised study, each at the same time so deeply influenced by the others that it must be studied against the background of the whole culture.

We can see this method well exemplified in the scheme of the Greek section in this library. The ethnographic foundation of Greek culture is given in the first volume on the formation of the Greek people. Economics, religion, art, science, politics are then studied in separate contributions, each written in a sociological spirit, each giving an analysis of one aspect of Greek culture, yet all connected into one comprehensive picture. The analysis of any other part of the scheme shows the same plan, and the names of the writers vouch for the fact that every contribution will be written in the modern scientific, that is, sociological spirit.

It is in this that the English series shows its superiority over the French library. In glancing over the prospectus of this latter, one or two capital omissions at once strike us forcibly. A series conceived in the sociological spirit should place perhaps two subjects in the forefront of its attention: economics and the study of domestic life. The importance of the former has been underestimated for ages by the historian, though it has certainly been over-emphasised in the modern theories of historical materialism. Nevertheless, childish as it is to regard wealth as the unique *vera causa* of all cultural process, its study cannot be omitted from any

scientific account of any type of civilisation. Even modern anthropology has begun to discover in theory and in field-work that the production and acquisition of material goods play a far greater part in primitive life than was ever suspected by the earlier authorities. In historical times, economics play an important part in the shaping of political history, of social organisation and of the other cultural pursuits, but certainly not as a unique and sufficient cause of everything, but as an element with which man cannot dispense, and which in consequence the student must not ignore.

The other factor, domesticity and family life, is, so to speak, the crucial test of really scientific anthropology and history. The most ubiquitous elements in man's life—the school of his infancy, the background of his youth and the aim of his age—the family and the household, are certainly the cell of human society, and their constitution influences deeply the other forms of social grouping in any culture. Modern psychology teaches us also that the early influences of the family leave a deep impression on the individual's mind and in consequence upon the whole cultural activity of a community. There is no doubt, however, that the scientific treatment of domesticity in its influence upon culture is extremely difficult. Just because it is so deep and powerful an influence, it is to some extent intangible and invisible; so that the modern historian finds in his sources only scanty and indirect information about the domestic life of the average individual, although archæology, folk-lore and even comparative anthropology can assist him in this to a great extent.

It is therefore a remarkable omission that in the French series the two subjects of economics and domestic life should have been almost completely neglected. This gap will be filled by Mr. Ogden in the English library, and he has summoned to this task the help of competent writers. The volume by Prof. J. L. Myres on "Woman's Place in Simple Societies," which is announced; the works on "Life and Labour in Greece and Rome," by M. Glotz and M. Paul Louis; the contribution on the regime of the castes in Ancient India, by Mr. G. S. Ghurye; the book on popular life in the last Roman Empire by Prof. N. Baynes; the volumes on "Life and Labour in the Middle Ages and in Modern Europe," by M. Boissonade and Prof. Renard, and on "Women in Medieval Times," by Dr. Eileen Power, the "Philosophy of Capitalism" and the "History of Money," both by Dr. T. E. Gregory—all these, confined to the English series—promise by their subjects to be among the most interesting volumes, and by their authors, among those of the greatest value in the library.

The comparison between the French and English series and the advantage derived from the combination of the best forces in two countries suggest the one serious criticism that could be made with regard to the present enterprise—the almost complete lack of German and American contributions. German scholarship in works referring to classical antiquity, in comparative linguistics, in many domains of psychology, in historical economics, jurisprudence and in the theory of the state is unrivalled. No one will suspect Mr. Ogden, the War-time editor of the *Cambridge Magazine*, of narrow-minded chauvinism or of any of the futile though unfortunately widespread prejudice against the science of a great nation. It is therefore to be hoped that in the pending additions to the series announced in the prospectus there will be included the works of some of the leading humanists of Germany.

It is also to be hoped that some of the best works of the United States to be published within the next few years will find their way into this series and make it even more representative and international. For in this big collective work on civilisation the unity of human culture and of human science should be manifested by the co-operation of different nations as well as in the intrinsic unity of the subject with which the authors are dealing.

B. MALINOWSKI.

Real Builders of America.

A Popular History of American Invention. Edited by Waldemar Kaempffert. Vol. 1: Transportation, Communication, and Power. Pp. xvi+577. Vol. 2: Material Resources and Labor-Saving Machines. Pp. xiv+457. (New York and London: Charles Scribner's Sons, 1924.) 63*s.* net.

TO the extraordinary development of the United States during the last century, history presents no parallel. From a position of comparative insignificance she has risen to be the greatest manufacturing nation the world has ever seen. The growth of her industries has indeed been remarkable, and the real builders of her fortunes have not been her statesmen and soldiers, but her mechanics and inventors. While, however, the story of her national progress is fairly familiar, a knowledge of her pioneers and their work is not general, and it was therefore a happy thought to bring together this series of essays giving a review of the great things achieved.

It was to an American audience that Lord Playfair once remarked, "Science has no country though its investigators have birthplaces." In some degree the same may be said of invention, and frequently the plan of writing the history of either science or invention from the national point of view is unsatisfactory. Still, there are advantages if the work is done impartially, and fortunately the editor and writers of this popular

history of American invention have not been too eager to emphasise the work of their countrymen at the expense of others, and the sketches, though by many writers, are throughout eminently readable, entertaining, and informing The work is well balanced, good accounts are given of scientific discoveries and mechanical inventions made in Europe before being taken up in the United States, and a large proportion of the illustrations are from the Science Museum, South Kensington, the Deutsches Museum of Munich, and other institutions We thus read the old stories of Watt and Stephenson, Volta and Faraday, Gutenburg, and Daguerre and Daimler, in a new setting

There are in all 27 chapters by 18 different writers, and the work is divided into five main parts devoted to transportation, communication, power, material resources, and labour-saving machines The opening chapter deals with railways, and in the year which is seeing the celebration of the centenary of the Stockton and Darlington Railway this is of especial interest American locomotives have long ago surpassed European engines in size and power, though not in speed and efficiency, and we are told that the largest goods engine, the Virginian, weighs 450 tons, and has no less than 10,725 square feet of heating surface in her boiler The *Rocket* had 137 square feet Several of the chapters give striking statistics, and in the first chapter it is stated that the United States now has 69,000 locomotives, 57,000 passenger cars, and 2,500,000 freight cars The railways employ about 2,000,000 men

After the story of the railways come those of the steam-boat, electric traction, motor cars and aeroplanes The next group of chapters is devoted to printing, typewriting—in 1919 the world produced 875,000 typewriters, of which 775,000 were American—telegraphs, telephones, wireless, photography, "Pictures that Live and Move," and phonographs Though the moving picture business owes its main development to American enterprise, a fair account is given of the work of Faraday, Plateau, Horner, Marey, and others, but the birthplace of the "movies" was Philadelphia, where at the Academy of Music in February 1870 Henry Heyl threw on the screen a series of pictures showing the movements of a couple waltzing The reader is taken behind the scenes of a studio, and it will perhaps come as news to many to read that some of the accidents seen on the films are real ones, and that Hubert Kittles, a well-known motorist, "was in bed for weeks with broken bones after a realistic motor cycle race, in which the story called for a real tumble"

The second volume of the history treats of the great metallurgical, oil, timber, machine tool, and textile industries We see how the inventions of Bessemer and Siemens led to the rise of Pittsburg, how petroleum wells are sunk, how giant forest trees are felled and transported, how the agriculture tractor came into being, and how boots are made by machinery, enabling the States to turn out 300,000,000 pairs of shoes a year Machine tools had their birth in the shops of Wilkinson, Bramah, and Maudslay, but to-day they are designed by the staffs of professional inventors maintained by the great companies They are characteristically American in the sense that they have been brought into being to solve the problem of producing vast quantities of metal articles cheaply in the face of high labour costs

In the space of 1000 pages it was, of course, impossible for the writers to deal with all the pioneers We thus miss any mention of James Rumsey and his steam-boat, of Ericsson and his gun turret, of the work of the great iron master John Fritz, and of Robert M'Alpine, the father of the wood pulp industry In the chapter on the incandescent lamp, Swan should certainly have been referred to But apart from these and other minor criticisms, it must be conceded that this popular history is one of the best books of its kind which have yet appeared

Bird Life on the Norfolk Broads

Broadland Birds By E L Turner Pp xvi + 172 + 51 plates (London *Country Life*, Ltd, 1924) 15s net

THAT skilful watcher and photographer of birds, Miss E L Turner, has published what she describes as "just a record of my own personal observations of the birds I have lived with for twenty years" She has had opportunities which many will envy, and has used them in a way which all must admire She has spent the whole of many seasons in a house-boat on Hickling Broad, devoting herself entirely to the observation of bird-life in that interesting locality By dint of much patient watching, she has acquired a great knowledge of the intimate lives of some of the most interesting and least accessible species What she has learnt she faithfully records as a plain narrative, avoiding anthropomorphic interpretation on one hand and not attempting theoretical deduction on the other The result will give much pleasure to lovers of birds, and at the same time is of considerable scientific interest

Several noteworthy ornithological events are recorded in these pages, such as the first nesting of the bittern, in 1911, after it had been for long regarded as extinct as a British breeding bird, and the nesting of the ruff in 1907 after an interval of many years The bittern, happily, is now re-established, but so far the ruff has not been found to nest regularly Miss Turner also describes the first nesting of the cormorant in

East Anglia for a century—on a high tree, as is commonly the case inland in Ireland and on the Continent

Other chapters in the book deal with birds which range from comparatively uncommon species, such as the stone-curlew and the bearded tit, to familiar birds which may be found in marshlands throughout the country About all of them we are told something of interest, but we are at the same time warned against hasty generalisation from the behaviour of a few individuals, because close observation reveals great differences in behaviour between one and another of the same species

The writer has not always restricted her stay in Norfolk to the nesting season, but has also spent the autumn and winter in her house-boat In late summer she has seen migrating swifts arriving from the north-east, appearing first at dawn as a faint cloud in the zenith which rapidly drops earthwards and resolves itself into a great host of birds In autumn she has seen the vast concourse of millions of starlings which roost in the reed-beds and perform aerial evolutions on such a scale that the line may " stretch from Potter Heigham Church on the south to Hickling Hill on the north-west, a distance of five miles " In mid-winter, with the broads nearly ice-bound, she has seen such things as fifty-four swans, in strict chevron formation, passing across the face of the moon

Miss Turner apparently began as a bird photographer, but she has become much more than that Her book would indeed have been well worth reading, as a record of observations, even without the excellent photographs with which it is illustrated, although naturally they add much to its charm Many of them are of value in depicting action instead of being portraits only

Our Bookshelf

La Géochimie Par Prof W Vernadsky (Nouvelle Collection scientifique) Pp vi + 404 (Paris Felix Alcan, 1924) 12 francs

THIS book of four chapters is a reprint, with some amplification, of lectures given by Prof Vernadsky at the Sorbonne during 1922–23 The first chapter, which opens with the questionable statement that geochemistry is a science new to the twentieth century, is devoted to general considerations, including the subdivision of the earth's outer layers or envelopes according to their physical, chemical and biological characteristics Apart from the atmospheric layers, Vernadsky's various groupings of these envelopes may be indicated roughly as follows

Superficial	Water and superficial crust	Biosphere
Metamorphic	Sedimentary and granitic	Lithosphere
Magmatic	Basaltic	Magmosphere

Minerals stable in the superficial envelope are termed *vadose*, those in the metamorphic envelope *phreatic*, and those in the magmatic envelope *juvenile* Cycles of change in the chemical composition of minerals are distinguished as *primary cycles* if their completion is effected in two or more envelopes, and *secondary cycles* if they are completed within the limits of a single envelope The application of these notions is illustrated by a detailed account of the geochemical history of manganese, which furnishes an example of a primary cycle involving juvenile, phreatic and vadose changes Chap ii deals with silica and the silicates, Chap iii with carbon and living matter, and Chap iv with the radioactive elements

A notable feature of the book is the large place allotted by the author to biochemical agencies in mineral transformations His account of the dynamic equilibrium between carbon dioxide and living matter, or what he calls the *vital cycle*, is of special interest from this point of view His discussion of biochemical evidence, however, shows that he is an enthusiastic supporter rather than a critical examiner of the claims made for biochemical factors in geochemical changes An example of this is provided by his reference to the process of laterisation, and his easy conviction that the process is clearly a biochemical one

In a general way, Prof Vernadsky's views are less likely to be challenged by chemists and physicists than by geologists , but it will be admitted by all that his book is full of interest on account of its largeness of outlook and its ample recognition of the many-sided character of geochemical problems T C

Physics in Industry Lectures delivered before the Institute of Physics Vol 2 By Dr J W Mellor, Dr A E Oxley, Prof C H Desch Pp 48 + 6 plates (London Oxford University Press, 1924) 3*s* net

THE appearance of a second volume of these valuable lectures on physics in industry evokes the thought—and the fear—that before long we may have a special society and a special journal devoted to this subject But for the fact that engineering has hitherto been regarded as the one and only field of applied physics that matters, these would probably have seen the light many years ago Industrial chemistry has long been in the public eye , industrial physics, apart from engineering, has yet to come into its own

In his absorbing lecture on the applications of physics to the ceramic industries, Dr Mellor was compelled by the tyranny of time to confine his remarks to applications that are not common to other industries, such as the drying of clay and clay wares, thermal and contraction strains in ceramic goods, and the electrical and thermal expansion of glazes He deals lucidly and suggestively with these topics, and his general remarks on applied physics and physicists, if not entirely novel, are very sound Dr Oxley, as physicist to the British Cotton Research Association, has found, contrary to expectation, a vast field for research in the textile industries, and particularly in bringing scientific method into the testing-room He points out that the distinguishing feature of physical research in this field is that, owing to great variability in the raw materials, series of observations sometimes involving many

thousands of readings have to be made, and conclusions drawn from them by statistical methods As examples of the work to be done he discusses the testing of rigidity, elasticity under strains, effects of variable stresses, fatigue, regularity of the spun thread, and the appearance of the finished fabric He concludes with the recommendation that abstracts on the progress of textile research should be given their place in the chief scientific journals The third lecture, on the physicist in metallurgy, shows the enormous importance of physics in later-day metallurgical research and practice The most numerous and varied applications of physics, states Prof Desch, are connected with the heating, forging, hardening, and alloying of metals Magnetism, he tells us, is becoming of increasing importance, and atomic structure, properties of crystals and X-ray analysis, are all of actual and potential value in metallurgical research The lectures reach a high standard, and the introductory remarks by the Hon Sir Charles Parsons concerning the rôle of higher mathematics in applied physical research should not be overlooked

Arabische Alchemisten Von Julius Ruska 2 Ǧa'far al-Sādiq, der sechste Imām Mit einer Nachbildung der Handschrift Gotha A 1292 (*Haleb* 338) *in Manuldruck* (Heidelberger akten der Von-Portheim-Stiftung, Heft 10) Pp 128+62 (Heidelberg Carl Winter's Universitatsbuchhandlung, 1924) 7 20 gold marks

PROF RUSKA's erudition is equalled only by his energy He has now followed up his monograph on Chālid ibn Jazīd (see NATURE, September 20, 1924, p 427) with an interesting and important memoir on Ja'far al-Sādiq, the sixth Imām Included in the memoir are the text and a translation (with full notes) of an alchemical treatise falsely attributed to Ja'far, the "Book of the Letter of Ja'far al-Sādiq on the Knowledge of the Art and of the Noble Stone" The text is a facsimile of MS *A* 1292 at Gotha, and is supplemented by additions and variations from a manuscript in the Library at Rampur

The memoir is divided into six sections (i) Ja'far al-Sādiq in history and legend, (ii) the writings attributed to Ja'far, (iii) Ja'far as the teacher of Jābir ibn Hayyān, (iv) Ja'far as the author of chemical works, (v and vi) translation and text of the alchemical treatise mentioned above Prof Ruska's main conclusions are that Ja'far had nothing whatever to do with alchemy, that all the alchemical works attributed to him are spurious, and that he could not have been the master of the great Jābir He says that it is quite unthinkable (*vollig undenkbar*) that Ja'far al-Sādiq could, at Medina, have come into any contact with either practical or theoretical alchemy If this conclusion is justified, it follows that Jābir could not have learnt alchemy from him, and Prof Ruska is therefore forced to the extremely important conclusion that "all writings ascribed to Jābir, in which Ja'far al-Sādiq is represented as his master and teacher, are to be regarded as falsifications of a later date"

Prof Ruska's conclusions are certain to have the happy result of provoking much further research, but we feel that it is as yet too early to give unqualified assent to his criterion for judging the authenticity of works ascribed to Jābir His memoir is undoubtedly the most important contribution to our knowledge of early Islamic chemistry which has been made in the present century E J H

Statics including Hydrostatics and the Elements of the Theory of Elasticity By Dr Horace Lamb Second edition Pp xii+357 (Cambridge At the University Press, 1924) 12*s* 6*d* net

PROF LAMB's books on the various branches of mechanics require no introduction to the modern teacher and student of applied mathematics By their fluency of diction, their easy mathematical style and their lucid presentation of the subject, they have displaced most of the old-established works The interest in the announcement of a new edition lies consequently rather in what modifications the author could possibly make to improve an already excellent work

This second edition of "Statics" differs from the earlier edition merely in the portion dealing with elastic problems There has been made, to the chapter on the extension of bars, a valuable addition on the treatment of redundancies Castigliano's theorem of least energy is developed, with Southwell's simple and elegant proof The chapter on the flexure and torsion of bars now covers the case of curved bars and the collapse of a ring under pressure, while the final chapter on stresses in cylindrical and spherical shells now includes the case of rotating cylindrical shafts

These additions are consistent with the general tendency of all the author's work, to combine with clear and lucid mathematics a close association with the realities of the subject This new edition merely emphasises the debt which all teachers owe to Prof Lamb's inspiration

Valenzkrafte und Rontgenspektren zwei Aufsatze uber das Elektronengebaude des Atoms Von Prof Dr W Kossel Zweite, vermehrte Auflage Pp ix+89 (Berlin Julius Springer, 1924) 3 60 gold marks

VALENCY and X-ray spectra may appear to have little in common, but valency is essentially connected with the number and distribution of the outer electrons of the atom, while X-ray spectra provide the most powerful weapon for the investigation of those which are more tightly bound, together, therefore, these two essays involve the whole question of electron distribution The first section contains an interesting account of the various theories of valency, and considerable space is devoted to the bearing of the crystal lattice on the problem This new edition has been slightly enlarged, notably by the inclusion of a brief account of the Lewis-Langmuir theory Bohr's work on the periodic table is not discussed here, since the author has decided, rightly perhaps, that it could be treated more adequately in the second essay Here Dr Kossel has succeeded in giving, in small compass, an admirable account of X-ray spectra and their bearing on atomic structure He emphasises the fact that an investigation of the energy levels indicated by these spectra leads to conclusions similar to those deduced from valency considerations The first edition was deservedly popular, and no doubt this second edition will meet with equal success, giving, as it does, a clear yet concise account of these phenomena

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE *No notice is taken of anonymous communications]*

X-ray Crystal Analysis as an Auxiliary in Organic Chemical Research

AT the suggestion of Prof W L Bragg, I recently sent to Dr G Shearer, of the Davy Faraday Research Laboratory, a series of four keto-acids which had been synthesised by my wife Dr Shearer was not aware of the identity of the substances, which were, however, stated to belong to the series

$$CH_3(CH_2)_m\ CO\ (CH_2)_n\ CO_2H$$

Actually (A) was $CH_3(CH_2)_{11}CO(CH_2)_8\ CO_2H$,
(B) was $CH_3(CH_2)_{11}CO(CH_2)_4\ CO_2H$,
(C) was $CH_3(CH_2)_7\ CO(CH_2)_6\ CO_2H$,
and (D) was $CH_3(CH_2)_8CO(CH_2)_8\ CO_2H$

No case so complex had been tried in the aliphatic series previously, and yet from the X-ray examination of a minute amount of these compounds, Dr Shearer was able to deduce that (A), (B), (C), and (D) have chains containing 22, 18 16, and 19 carbon atoms respectively Furthermore, it was possible to assign positions to the carbonyl groups in (A), (B), (C), and (D) from a consideration of the distribution of intensity among the various orders of reflection from the principal planes and it was found that the carbonyl group is 0 52 0 67, 0 55, and 0 50 respectively of the whole length of the molecule from the end terminating in a methyl group The corresponding theoretical values are 0 54, 0 65 0 50, and 0 48, which means a maximum error of one carbon atom in placing the oxygen

The outcome, considering the difficulties, is remarkable, and this is surely the most noteworthy invasion which the physicist has yet made of the domain of the purely structural organic chemist The specimen (B), for example, is identical with an acid found by Bougault and Charaux (1911) in various species of Lactarius, and therefore called lactarinic acid Its relation to stearic acid was quickly realised, but a determination of the situation of the carbonyl group involved a longer investigation Should such a case arise again, we can replace the analytical research by an X-ray examination and confirm the conclusions by direct synthesis

In view of the importance of the normal-chain unsaturated acids in biochemistry and their ready conversion into crystalline oxygenated derivatives, there can be little doubt that Dr Shearer s work will find many applications even in this restricted field On a broad view the possibilities are limitless, and gradually more and more groups of carbon compounds will become amenable to this kind of direct examination Our more difficult problems, such as that presented by the determination of the molecular structure of strychnine, cannot be completely solved by X-ray analysis at the present time, yet, even here, Sir William Bragg has recently made a suggestion in regard to a possible utilisation of the method It is to *stain* the molecule with heavy halogen atoms and locate these at least in the crystal

A different kind of use for the X-ray spectrograph in organic chemistry is illustrated by a further incident Mrs Robinson has synthesised the two keto-stearic acids $CH_3(CH_2)_7\ CO(CH_2)_8\ CO_2H$ and $CH_3(CH_2)_8\ CO\ (CH_2)_7\ CO_2H$, which are the possible products of hydration of stearolic acid, $CH_3(CH_2)_7\ C{\equiv}C\ (CH_2)_7\ CO_2H$ It is stated in the literature that the addition of the elements of water to stearolic acid gives only the first-mentioned keto stearic acid, but both synthetical acids melt at a higher temperature than does the substance derived from stearolic acid Possibly the latter is a mixture of the two, and in order to confirm this view we had recourse to Dr Shearer He found that the principal spacings in the three specimens were identical, but that the intensity distributions among the different orders of reflection from the principal planes showed marked differences in the case of the two homogeneous acids, whilst the intensity distributions were intermediate in the case of the acid derived from stearolic acid It is almost certain, therefore, that the acetylenic linkage of stearolic acid is hydrated in each of the theoretically possible directions when the substance is treated successively with sulphuric acid and water

R ROBINSON
The University Manchester

The Structure of Stearic and Stearolic Acid

CRYSTALS of fatty acids and similar long chain compounds are difficult to obtain in sizes large enough to give good "single crystal" X-ray photographs Mr W B Saville has succeeded in growing fairly large and thick crystals of stearic acid They were obtained from a saturated solution of stearic acid in carbon bisulphide

X-ray analysis shows that stearic acid crystals obtained under these conditions are monoclinic The size of the unit cell is found to be $a=5\ 60$, $b=7\ 38$, $c=50\ 9$ Å U, and $\beta=59\ 7°$ The choice of the unit cell is to a certain extent arbitrary, these data give the lowest indices to the strongest reflecting planes The density is slightly more than 1 05, this gives four molecules to the unit cell Previous work on series of similar compounds led to the conclusion that the carbon atoms are arranged in long and uniform chains The c axis in the present case has been put in a plane of highest density The chain which coincides nearest with the c axis is found to be of the tetrahedral type if the diameter of the carbon atom is taken over from the diamond structure

A single crystal of stearolic acid investigated by means of X-rays gave different photograms from those obtained from stearic acid The symmetry is lower, and all the data seem to indicate that these crystals are triclinic Stearolic acid has the same number of carbon atoms as stearic acid (18), but it has a triple bond in the middle of the chain

ALEX MULLER
Davy Faraday Laboratory,
Royal Institution,
July 1

Solar Activity and Atmospheric Electricity

IN view of the footnote to Dr Chree's article in NATURE of June 27, and an explanatory note received from him recently that his article was in type before he saw my article in the March issue of the journal *Terrestrial Magnetism*, it would scarcely be fair to him to make any comments However, I shall be glad to send a reprint of my article to any one interested in becoming acquainted with all the points involved Furthermore, since my March article, we have found Dr Chree's recommendation made at the Madrid meeting of the Geophysical Union impracticable Meteorologists have likewise not adopted his recommendation for their purposes

We are investigating other interesting questions in atmospheric electricity, but are obliged first to recompute the early Kew observations, because Dr Chree did not utilise concomitant observations at Greenwich In the hope that British investigators will assist in securing the desired world-wide distribution of electric observatories during the present solar cycle, permit me to direct attention to the fact that the two observatories in Great Britain are unfavourably located, and that the only atmospheric electric observations in British oversea countries are being made in Australia and Samoa at the expense of the Carnegie Institution of Washington Other countries are co-operating Also, no earth current observations to our knowledge are being made under British auspices

LOUIS A BAUER

Washington, D C, June 24

THE article by me in NATURE to which Dr Bauer refers included a discussion of Potsdam data These data had also been treated by Dr Bauer in the March number of *Terrestrial Magnetism* Dr Bauer having sent me a copy of his article, I informed him when acknowledging it that I had also discussed the Potsdam data in an article which was already in type I wished to make it clear—to prevent misunderstanding—that my article, the conclusions in which differed from Dr Bauer's, was written quite independently Beyond informing Dr Bauer that our conclusions differed, and continue to differ, I did not tell him the substance of my article but only that of the footnote

In the absence of information, he would seem to have supposed that the article referred to a suggestion, originally made in a presidential address to the Royal Meteorological Society (Quarterly Journal Roy Met Soc, vol 50, p 96), that a comparison should be made between the meteorological and electrical conditions on the international magnetic quiet and disturbed days The British meteorological delegates to the meeting of the International Union of Geodesy and Geophysics, held last year at Madrid, put forward an analogous proposition, but another proposition originating from Denmark received a greater number of votes As to the practicability of the proposition, I am naturally disposed to prefer the opinion of the meteorologists on the British National Committee of Geodesy and Geophysics to Dr Bauer's

In his references to the unfavourable situation, for observations on atmospheric electricity, of existing British observatories, I think Dr Bauer must have forgotten Eskdalemuir, which unlike Kew and Greenwich is remote from any large town He is also presumably unaware that some provision has been made for electrical observations at the new observatory at Lerwick

We are all I hope, aware of the energy and enterprise of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington Our only regret is that Mr Carnegie, or some other millionaire, has not similarly endowed a geophysical institution for the British Empire

CHARLES CHREE

June 25

The Sun-Clock

I AM the fortunate custodian of a model—the only one in Great Britain—of a new kind of sun-dial, the invention of Prof W E Cooke, the Government Astronomer of Sydney, N S W

It is much more than a sun-dial It is provided with a movable pointer geared to the hands of an ordinary clock-face and by virtue of this it is aptly called the sun clock

At any time when the sun is shining, it is turned as directed in one simple motion, and immediately G M T is read on an ordinary clock dial to within half a minute, the seasonal variations of solar time and the difference due to the longitude of the place in which it is set up being compensated for in the design of the instrument

Reading the time on an ordinary sun-dial involves first the observation of the precise position of the edge of the shadow, which, owing to lack of definition may be very difficult to read to an accuracy of one minute Reference must then be made to an equation table, and whatever number of minutes are appropriate to the date must be added or subtracted in order to arrive at mean solar time Then to ascertain Greenwich Mean Time, a further correction is required

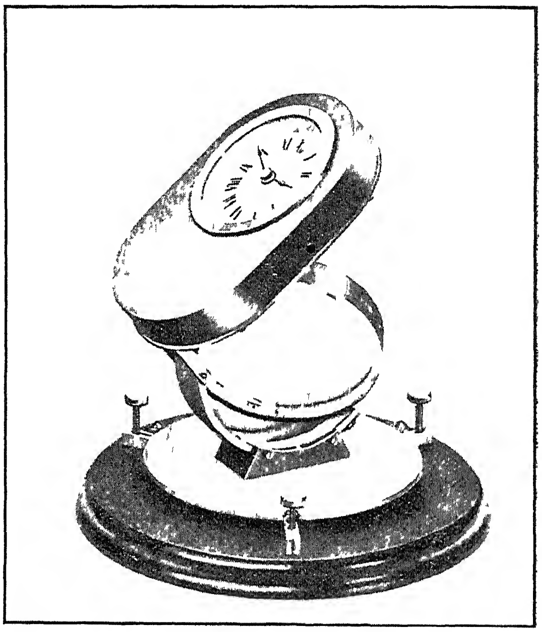

FIG 1 —The sun clock

for the longitude of the position of the sun dial, east or west of Greenwich

In the sun-clock no such mental gymnastics are required It will be seen from the illustration (Fig 1) that instead of a gnomon, there is a pivoted brass ring the axis of which is in exactly the same plane as the gnomon would be if there was one that is to say, its pivots lie along a line which points true north, and the angle of its tilt is equal to the latitude of the place at which it is fixed There is a small hole on one side of the ring, well countersunk on the outside On the inner surface of the ring, diametrically opposite to this little aperture, is engraved an analemma or graph in the form of a figure 8 to show the equation of time, or the difference between apparent and mean time, for every day in the year

When it is desired to know the time, the ring is turned until the spot of sunlight is on the analemma The ring is geared to the hands of a clock, and in the act of turning it they are set to G M T It is not necessary to look at the date, but, incidentally, the date is there to the very day, indicated by the spot of light, and had Robinson Crusoe been the happy possessor of a sun-clock it would have served him as

a perpetual calendar, and he need not have notched his tree

It is said that there is nothing new under the sun, but this appears to me to be an original invention and a brilliant one

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The Amani Research Institute

MAY I be allowed to add to the timely and sympathetic article on the Amani Research Institute in NATURE of June 20, p 933, some notes on a point not emphasised by you, namely, the possibilities of Cinchona cultivation at Amani ?

From the outbreak of war in 1914 Amani was used as a refuge camp for women and children, and, until its occupation by the British in 1916, its resources, thanks to the abilities of the German scientific staff were ruthlessly exploited for the benefit of the German armies in the field Thus, of the " economic products," catalogued under 67 heads manufactured at the Institute may be mentioned 830 kgm of plant butter ' from the seeds of *Allanblackia Stuhlmannii*, 15 000 bottles of " Amani whisky " (a fearsome liquor) and medicinal alcohol, and about 400 bottles of castor oil But most important of all were 136 kgm of quinine sulphate, extracted at Amani, and 4000 kgm of Cinchona bark sent to be worked up at the veterinary station at Mpapua Prof A Zimmermann the German Director of Amani, came to East Africa from Java, and brought with him both seeds of Cinchona and a knowledge of its cultivation and the quinine plantations in the event proved one of the best investments the German Government ever made They certainly helped materially to keep the German troops in the field Of the three varieties of Cinchona grown in the Institute grounds—*C Ledgeriana*, *C succirubra*, and a hybrid (Java seed) between these two—the last assayed so well and earned so remarkable a report from the Imperial Institute that it is deserving of a wide publicity Full details can be found in the Bulletin of the Imperial Institute, vol 16, No 3 I need only extract the analysis of the bark

No 4 *C Ledgeriana* × *C succirubra*

	Per cent
Moisture	7 50
Total alkaloid	11 30
Quinine	8 41
Cinchonidine	nil
Yield of crystallised quinine sulphate	11 21

and the manufacturer's opinion

" The manufacturers stated that sample No 4, the hybrid from *C Ledgeriana* × *C succirubra*, is one of the highest quinine-yielding barks they have examined, being fully equal to the finest Ledger bark from Java "

So far as experience has gone, Cinchona flourishes in East Africa only in the East Usambara Mountains, where the atmosphere is moist and the temperature remarkably low for the elevation (under 4000 ft) Certainly I have not heard of its doing really well elsewhere in Tanganyika Territory, or in Kenya Colony But in the neighbourhood of Amani there are thousands of acres of virgin forest land which appear to be suitable for Cinchona My instructions, in view of the report on the hybrid, were to devote special attention to quinine cultivation, and when I left Amani at the end of 1923 we had some promising plantations of Ledgeriana and the hybrid (Amani seed) coming on, and, thanks to Prof Greenish and the Director of the Wellcome Bureau of Scientific Research, some assays of the bark of known, mature hybrid trees, which confirmed the original analysis and promised to open up a tempting field of research It had always been my hope that eventually Amani would do for the East African Colonies what Sir David Prain had done for India, and supply most of the quinine needed locally, particularly for native consumption

ALLEYNE LEECHMAN
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Spectroscopic Evidence of *J*-Transformation of X-rays

IN our letter to NATURE of April 25 on spectroscopic evidence of *J*-transformation of X-rays, we pointed out that there are alternative conclusions regarding the experimental results which were taken from the Table V given by Prof Siegbahn in " Über die Rontgenspektren der chemischen Elemente," Jahrbuch der Radioaktivitat, 1916 These conclusions are *either* the wave-length determinations quoted are inaccurate to the extent of more than 1 per cent , *or* the discontinuities which occur in $K\alpha_1$, $K\alpha_2$, $K\beta$ are real and are due to *J*-transformation of X-rays Prof Siegbahn gives as his judgment that the irregularities are due to experimental error we accept this

The values given in the Jahrbuch are evidently those of Malmer—according to Prof Siegbahn " not very concordant measurements " (NATURE, July 4, p 11) At the same time Prof Siegbahn states that Malmer's " measurements give no evidence of such a sudden change in the slope of the curve as shown in the letter of Messrs Khastgir and Watson " We should like to point out however, that the irregularities referred to by us have been noticed independently by J M Cork (*Phys Rev* , Feb 1925, p 197) Further, Gunther, so late as 1924, has quoted these same values in a booklet of X-ray spectroscopic measurements and we employed them because they constituted at that time the only available complete set of wave-lengths throughout the region where the *J*-phenomenon appears

Mr Nipper (NATURE, July 4, p 12) is evidently not acquainted with the facts concerning the *J*-phenomenon (see *Phil Mag* , May 1925), otherwise he would not have advanced as evidence against our main contention the fact that Siegbahn s later—or for that matter any other spectroscopist's—values do not show a discontinuity (increase in λ as Z is increased from 51 to 52) It was explicitly stated in our letter, and it has been emphasised by Barkla on many occasions, that wave-length is not the only factor which determines whether or not *J*-transformation of X-rays takes place in transmission through matter Certain critical conditions are necessary the character of the whole of the radiation transmitted appears to exercise a very important controlling influence (see NATURE, June 20, 1925, p 942) The *J*-transformation evidently did not occur in the case of Siegbahn's recent determinations of wave-length, and we therefore obtain from them no evidence of the *J*-phenomenon

S R KHASTGIR
W H WATSON

Physical Laboratory,
University of Edinburgh,
June 19

The Cresswell Engravings

Mr J Wilfrid Jackson, in his letter to Nature of June 6, p 874, refers to the occasion when he first saw these engravings and says, "I also told him it was a mistake to outline the figures in chinese white" I am quite sure Mr Jackson did not intend it to be so, but, none the less, this is a misleading statement and open to a wrong interpretation The engravings were not outlined in white, and only one specimen, the reindeer piece, has ever been so outlined This example is executed in very fine, thin, lines upon bone afterwards scorched black by fire, hence the drawing is not readily seen unless the bone is held at the correct angle For photographic purposes chinese white was *rubbed* into the lines, as a satisfactory picture could not be obtained otherwise

Sir William Boyd Dawkins asked me to send the engravings to him for inspection, and photographs were sent with them As an act of courtesy, the reindeer piece was forwarded in the condition in which photographed, and my covering letter expressly pointed out that it was sent thus outlined to assist him in his examination and that the outlining could be removed immediately by the application of a sponge or damp handkerchief As neither he nor Mr Jackson took the trouble to do this, they are scarcely in a position to express a trustworthy opinion upon the character of the lines composing the figure Had they done so, they would have seen at once that the lines are clean, sharp, continuous cuts, and bear no resemblance whatever to the half-tunnels formed by roots Mr Jackson's interpretation of certain selected markings upon an ancient skull are interesting, but no one familiar with the technique of Palæolithic art could mistake these broken lines upon the portion he illustrates for the handiwork of man

The authenticity of the engravings from Mother Grundy's Parlour, Cresswell, is testified by the authorities at the British Museum, by Mr Miles C Burkitt of Cambridge, the foremost British authority on Palæolithic art, Prof Sollas, and others The considered opinion (with full knowledge of Mr Jackson's objection) of M L'Abbe Breuil relative to the specimens was reported in Nature of May 2, p 658

A Leslie Armstrong

14 Swaledale Rd ,
Sheffield, June 25

Ancient Science

Permit me to supplement two passages in Nature of June 20

P 963, *Accuracy of Weighing in the Eighth Century* — In 1885 I found a hoard of fifty-eight Athenian tetradrachms of uniform type and unworn condition I reduced the chloride on each by means of zinc and so obtained the original weights The average was 264 2 grains, with a mean variation of 0 6 grain Thus 4/5 of the coinage of Athens would have passed the remedy of the Mint in modern England This must evidently have been the result of careful weighing and adjustment In a group of small Gaulish silver coins, from Chalons-sur-Saône, which I bought in Paris, the average is 29 85 grains and the mean variation 0 33 grain, so it is evident the balance was used in Gaul Weights are found in prehistoric Egypt so far back as 8000 B C

P 937, *Egyptian Mathematics* —The most frequent kind of problem in the Egyptian mathematical papyrus, that of dividing a stock of food, seems to be the origin of their fractional system If 2 loaves have to be divided among 7 people, the obvious way is to divide the stock into 8 parts, distribute 7, and divide the remaining quarter of a loaf into 7 parts Thus 2/7 naturally becomes 1/4 + 1/28 The same system was used in dividing the profits of Scotch fishing-boats The master served out a pound to himself, a pound to each of his crew, and a pound for the boat When there were not enough pounds to go round, the remainder was changed into half-sovereigns, the next remainder into half-crowns then shillings, then pence, and finally sweeties The system seems obvious in all cases where written accounts were not prepared

Flinders Petrie

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On the Daily Use of an Immersion Condenser

In daily observations on the structure of chromosomes fixed and stained in iron-acetocarmine (see *American Naturalist*, 1921, pp 573-574), where the limit of resolution in the microscope must be maintained, it has been determined that water is, on the whole, to be preferred to cedar oil as an immersion fluid for the condenser The corrections necessary are readily made (1) By centring a large enough meniscus lens from a photographic camera below the condenser (Hartridge), and varying the distance of the light source, and the thickness of the object slide, until the best image of a grating close to the light source is obtained (2) By unscrewing sufficiently the top lens or lenses of the condenser Slides can easily be selected of approximately the required thickness The test for aplanatism is, of course, to diaphragm the source of light until its image is equal to or smaller than the field of view, and then observe the light circle at the back of the objective

Cells in iron-acetocarmine become plastic after a certain time, and can be squeezed flat by slight pressure When the chromosomes are thus spread out in contact with the cover-glass there is a good opportunity to seek for possible visibility of the chains of genes, either with the Watson dark field condenser of 1 3-1 4 aperture, or with the arc and two tourmalines, as mentioned by Beck in his lately published manual

John Belling

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Cold Spring Harbor, L I ,
New York

The Faraday Benzene Centenary and Kekule

In connexion with the benzene centenary it may perhaps be pointed out that the name Kekule is not French August Kekule, born in Darmstadt (1829), he died in Bonn, 1896), was a descendant of Wilhelm Dionysius Kekule (or Keckhule) von Stradonitz, who came from Bohemia in the seventeenth century The e was probably adopted to guard against the suppression of the final e, that has been done in other cases August Kekule himself spelt his name with e, even in his earliest papers before he went to Ghent and Bonn and still in 1890 when his researches on the construction of aromatic compounds and the twenty-fifth anniversary of his benzene-hexagon (Bonn, 1865) were commemorated by an international Kekule celebration at Berlin But he had by that time (1890) resumed the full name A K von Stradonitz The present members of the family spell their name without the accent

H Borns

Chiswick, June 30

Ether-Drift Experiments at Mount Wilson

By Prof Dayton C Miller, Case School of Applied Science, Cleveland, Ohio

THE Michelson-Morley experiment for determining the relative motion of the earth and the luminiferous ether, the "ether-drift experiment," was first performed in Cleveland in the year 1887, by Prof Albert A Michelson and the late Prof Edward W Morley The theory of the experiment and a description of the apparatus was published in the *Philosophical Magazine* for 1887, and has been repeated in many text-books since that time They announced their conclusions as follows "Considering the motion of the earth in its orbit only the observations show that the relative motion of the earth and the ether is probably less than one-sixth the earth's orbital velocity and certainly less than one-fourth" (That is, it is less than 7 5 kilometres per second) This result was considered by many as a null result, often called a negative result, and by some was thought to throw grave doubts upon the validity of the hypothesis of the luminiferous ether

At the International Congress of Physics, held in Paris in 1900, Lord Kelvin expressed the conviction that the experiment should be repeated with a more sensitive apparatus The present writer, in collaboration with Prof Morley, constructed an interferometer about four times as sensitive as that used in the first experiments, having a light path of 224 feet, equal to about 150,000,000 wave-lengths In this instrument a relative velocity of the earth and ether equal to the earth's orbital velocity would be indicated by a displacement of the interference fringes equal to 1 5 fringes This apparatus was used in the basement of the Physical Laboratory of Case School of Applied Science in Cleveland, observations being made in 1904 and 1905 The result of these observations was published in the *Philosophical Magazine* for May 1905, as follows "We may, therefore, declare that the experiment shows that if the ether near the apparatus did not move with it, the difference in velocity was less than 3 5 kilometres per second unless the effect on the materials annulled the effect sought Some have thought that this experiment only proves that the ether in a certain basement-room is carried along with it We desire, therefore, to place the apparatus on a hill to see if an effect can be there detected"

In the autumn of 1905 Morley and Miller removed this interferometer from the college laboratory to a site on Euclid Heights, Cleveland, at an altitude of 300 feet above Lake Erie and free from obstruction of buildings Five preliminary observations were made which gave indication of a positive effect as of an ether-drift of about one-tenth of the then expected drift We were compelled to discontinue these experiments by circumstances beyond our control, before any definite results could be obtained

The indication of a small positive effect made it seem necessary to continue the experiments, but it was thought desirable that further observations should be carried out at a much higher altitude Prof Morley retired from active work in 1906 and the continuance of the observations was long delayed The suitable opportunity for continuing the experiments came in 1921, and upon the invitation of Prof George E Hale, Director of the Mount Wilson Observatory in California, the interferometer which had been used in 1905 was remounted at the Mount Wilson Observatory Four distinct groups of observations have now been made in this location in March and April 1921, in November and December 1921, in August and September 1924, and in March and April 1925 The first observations at this Observatory gave a definite, positive result considerably larger than that previously obtained in Cleveland, being equal to about one-third of the earth's orbital velocity

On the simple theory of the ether-drift experiment, it is presumed that the system of interference fringes which is observed will suffer a periodic displacement as the interferometer is rotated in the horizontal plane, this displacement being proportional to the relative motion of the earth and the ether The rotation of the earth on its axis causes the plane of the interferometer to move as though it were on the surface of a cone the axis of which coincides with that of the earth, and thus to take many different space orientations It is only that component of the actual drift which lies in the horizontal plane of the interferometer at the moment of observation which can be observed Therefore, the *apparent* azimuth and magnitude of the drift should change with the time of observation A drift perpendicular to the plane of the interferometer will produce no effect whatever, it is quite possible that this condition may occur at certain times of the year

It was suggested that the small observed effect might be due to magnetism acting on the steel frame of the interferometer, or that it might be due to radiant heat or other instrumental disturbances The trying out of the various suggestions has involved continuous experimentation during the last four years, in which time every suspected cause of disturbance has been investigated, and it has been shown that none of these causes is responsible foi the observed displacement

In the summer of 1921 the steel frame of the interferometer was dismounted and a base of one piece of concrete reinforced with brass was cast in place on the mercury float All the metal parts were made of aluminium or brass, thus the entire apparatus was free from magnetic effects and the possible effects due to heat were much reduced In December 1921, 42 sets of observations consisting of 900 single measures of the drift were made with the non-magnetic interferometer These show a positive effect as of an ether-drift which is entirely consistent with the observations of April 1921 Many variations of incidental conditions were tried at this epoch Observations were made with rotations of the interferometer clockwise and counter-clockwise, with a rapid rotation and a very slow rotation, with the interferometer extremely out of level, due to the loading of the float on one side Many variations of procedure in observing and recording were tried The results of the observations were not affected by any of these changes

The entire apparatus was returned to the laboratory

in Cleveland During the years 1922 and 1923, many trials were made under various conditions which could be controlled and with many modifications of the arrangements of parts of the apparatus An arrangement of prisms and mirrors was made so that the source of light could be placed outside the observing room, and a further complication of mirrors was tried for observing the fringes from a stationary telescope Methods of photographic registration by means of a motion picture camera were tried Various sources of light were employed, including sunlight and the electric arc Finally, an arrangement was perfected for making observations with an astronomical telescope having an objective of five inches aperture and a magnification of fifty diameters The source of light adopted was a large acetylene lamp of the kind commonly used for automobile headlights An extended series of experiments was made to determine the influence of inequality of temperature and of radiant heat, and various insulating covers were provided for the base of the interferometer and for the light path These experiments proved that under the conditions of actual observation, the periodic displacement could not possibly be produced by temperature effects An extended investigation in the laboratory demonstrated that the full-period effect mentioned in the preliminary report on the Mount Wilson observations is a necessary geometrical result of the adjustment of mirrors when fringes of finite width are used, and that the effect vanishes only for fringes of infinite width, as is presumed in the simple theory of the experiment

In July 1924 the interferometer was taken again to Mount Wilson and mounted on a new site where the temperature conditions were more favourable than those of 1921 The interferometer house was also mounted with a different orientation Again the observations showed a definite positive effect corresponding to the observations previously made at Mount Wilson The observations on Mount Wilson were resumed in March 1925, and continued until about the middle of April, during which time 1600 measures of the drift were made Again many variations in detail of arrangement of parts and in methods of observing were made without in any way altering the result Throughout the latter epoch of observations the conditions were exceptionally good The observations of April 1925 give results almost identical with those of April 1921, notwithstanding that the interferometer had been rebuilt and that a different system of illumination and different methods of observation were employed, and that it was mounted on a new site in a house differently oriented

The interferometer readings being plotted, give directly by harmonic analysis the azimuth and magnitude of the ether-drift There are no corrections of any kind to be applied to the observed values In the work so far, every reading of the drift made at Mount Wilson has been included at its full value, no observation has been omitted because it seemed to be poor, and no "weights" have been applied to reduce the influence on the result, since no assumption has been made as to the expected result It may be added that while the readings are being made, neither the observer nor the recorder can form the slightest idea as to whether any periodicity is present, much less as to the direction or amount of such periodicity

The ether-drift experiments at Mount Wilson during the last four years, 1921 to 1925, consisting of about 5000 single measures of the drift, lead to the conclusion that there is a positive displacement of the interference fringes, such as would be produced by a relative motion of the earth and the ether at this Observatory, of approximately ten kilometres per second, being about one-third of the orbital velocity of the earth By comparison with the earlier Cleveland observations, this suggests a partial drag of the ether by the earth, which decreases with altitude A more extended account of these observations is given in the Proceedings of the National Academy of Sciences for June 1925

Dr Ludwik Silberstein, in his letter to NATURE of May 23, has pointed out that these results, indicating a partial drag of the ether by the earth, "are easily explicable by means of the Stokes' ether concept, as modified by Planck and Lorentz," as discussed in a paper by Silberstein in the *Philosophical Magazine* for February 1920

The final test of these observations is whether they lead to a rational and wholly consistent indication of a constant motion of the solar system in space, combined with the orbital motion of the earth and the daily rotation on its axis There is a specific relation for a given latitude between the observed azimuth of drift and the sidereal time of observation Observations at different sidereal times should show different azimuths, and all observations at the same sidereal time should show the same azimuth for a given epoch It is believed that a reconsideration of the Cleveland observations, from this point of view, will show that they are in accordance with this presumption, and will lead to the conclusion that the Michelson-Morley experiment does not and probably never has given a true zero result A complete calculation of the observations, now in progress, together with further experiments to be made in the immediate future, should give definite indications regarding the absolute motion of the solar system in space

The Science Exhibition at Wembley

THE Science Exhibition arranged by a Committee of the Royal Society in the Government Pavilion at Wembley represents a great advance on the similar exhibition held last year, particularly as regards the section devoted to physics The space available has been considerably extended and the equipment of the demonstration benches is much more adequate Perhaps the most striking advance, however, is the admirably systematic manner in which it is now possible to present the exhibits, for these have been arranged on an underlying plan which gives unity to the whole and converts a collection of miscellaneous experiments into an orderly sequence of demonstrations, which are not only striking in themselves but also calculated to give visitors a very fair impression of the nature of modern physics and the scope of the problems to which it addresses itself The key to this part of the exhibition is to be found in an enormous chart, some 24 ft long,

showing the wave-lengths of electromagnetic radiation as a continuous series according to a logarithmic scale, the general nature of the radiation and the methods by which it is detected and generated being shown against each range of wave-lengths This chart itself, which covers 60 octaves, is of considerable interest, particularly as regards the regions of overlap For example, it has in recent years become possible to generate and detect radiation the wave-length of which is a few tenths of a millimetre both by thermal and by electromagnetic methods It is a remarkable fact that it is now possible to use a scale of wave-lengths as a guide to a very representative series of physical experiments it emphasises the change which has taken place in the orientation of scientific thought since the days when matter was everything and energy had not been defined, for now energy is paramount and matter is mentioned as an afterthought

Bearing in mind the general scheme indicated by the chart, the visitor is conducted along a series of excellently appointed benches designed to illustrate the properties of the various types of radiation, beginning with the shortest He is first introduced to the atom, as the source of gamma radiation, and this is represented by some new models in addition to apparatus which will be familiar to physicists On the ceiling the relative distances of the electrons and nucleus in a neon atom are shown by means of coloured lamps, and further models, for which Prof W L Bragg and Mr D R Hartree are to be responsible, are awaited with interest Another striking exhibit connected with atomic structure is an apparatus from the Clarendon Laboratory in which a single particle at a time, emitted by polonium, is made to break down the resistance of a small spark gap, the resulting current being made audible by means of amplifiers and a loud speaker The properties of gamma rays are illustrated by a projection electroscope contributed by Dr E A Owen, the rate of discharge being varied by placing various screens in the path of gamma rays emitted by radium

Amongst the experiments connected with X-ray apparatus may be noted a very fine demonstration due to Mr F D Edwards of the electric discharge through air at gradually decreasing pressure in a tube 4 ft 6 in long The large scale of the apparatus makes these always beautiful effects very striking, and the rise in resistance of the tube at the highest and lowest pressures is indicated by sparks across a 10-inch alternative gap A less familiar demonstration is afforded by de la Rive's apparatus in which a luminous arc passes from an electrode at the top of a discharge tube to a ring electrode at the bottom, the core of an electromagnet being located in the axis of the ring The arc is seen to rotate in one direction or the other according to the polarity imparted to the electromagnet Dr G W C Kaye contributes a soft X-ray apparatus with which visitors can study the transparency of various substances by the aid of a fluorescent screen, and there are exhibits illustrating the application of X-rays to crystal structure Bridging the gap between X-rays and ordinary ultra-violet light we have the Schumann X-rays, produced by the impact of electrons the velocity of which is measured by some hundred volts, and detected by their photo-electric effect on the insulated electrode of an electrometer It was in this region that the "death-ray" was alleged to lie

The ultra-violet range is illustrated by several demonstrations of which the most intriguing is perhaps one due to Sir Herbert Jackson, in which mixed visible and ultra-violet rays from a condensed aluminium spark are focussed by a quartz lens on a screen which fluoresces to ultra-violet rays of wave-length 1850 or 1860 Å U The visible rays are found to be focussed at about 2 ft from the lens and the ultra-violet of the above wave-lengths at about 8 inches, so that by moving the screen it is possible to find two differently coloured focal regions Mr Guild contributes a visible spectrum projected by means of a calcite prism The existence of radiation beyond the visible spectrum is shown by means of a thermopile at one end and a zinc sulphide screen at the other, and the effect of interposing various colour filters is shown by a comparison of the filtered spectrum with a patch of otherwise white light which has passed through the filter Dr Curtis shows that on increasing an electric discharge through nitrogen by shunting the break of the induction coil with a condenser, the disruption of the nitrogen molecules changes a band spectrum into a line spectrum, and a similar contrast is obtained by Prof Fowler by means of a flame arc containing calcium fluoride, the band spectrum due to the fluoride being accompanied by a line spectrum due to the dissociated elements Prof Horton and Dr Ann Davies illustrate the nature of light emission with an apparatus for showing excitation potentials, and there are photoelectric cells in action contributed by the Clarendon Laboratory and Mr T H Harrison Interference phenomena in the visible range are represented by a Michelson interferometer (Mr Twyman), Lippmann colour-photographs (Mr Gamble), diffraction gratings from the National Physical Laboratory (Mr J S Clark), and a demonstration due to Prof Rankine of the projection of an image of a luminous object by means of a spherical bicycle ball in place of a lens Each point in the object throws a circular shadow of the ball having a white spot at its centre, and the aggregate of white spots forms the required image Photographs can be reproduced by this method Polarisation apparatus is shown by Prof Cheshire

For the infra-red region Mr Twyman has a spectrometer with a rock-salt prism which can be turned by a micrometer screw so as to traverse the spectrum across a thermopile The spectrum from 5,000 to 100,000 Å U can be explored in this way, and a Bunsen burner is shown to emit strongly in the neighbourhood of 44,000 Å U A caesium photo-electric cell, which is sensitive to infra-red rays, is contributed by the Clarendon Laboratory, an ebonite screen serving to filter out the visible light The transition to wireless wave-lengths is afforded by Mr F E Smith's demonstration of the production and heating effects of very short Hertzian waves, and by Sir William Bragg's example of Lindman's apparatus for rotating the plane of polarisation of such waves by means of an arrangement of metal spirals, the action being similar to that of quartz and other crystals which are optically active in the visible region

The interest of the non-scientific visitor, for whose benefit the Exhibition is primarily intended, will no doubt be specially caught by the display of wireless

apparatus, of which a few examples only can be mentioned The Lecher wires (Prof Whiddington) will illuminate the conception of wave-length, and apparatus by Dr Smith-Rose demonstrates the rectifying property on which crystal detectors depend The determination of absolute frequency by Mr D W Dye's recently perfected oscillograph system is also a feature in this section of the Exhibition The cathode-ray oscillograph is caused to give a circular trace by means of crossed fields controlled through a valve by a standard tuning-fork, the ray completing the trace once per vibration of the fork By the superimposition of a supplementary pair of crossed fields at high frequency the circular trace is transformed into a closed series of loops when the frequency is a harmonic of the fork frequency, and can be calculated from that and the number of loops In this way standardised high frequencies can be obtained The same apparatus is used to give wave form by transforming the circle into a long ellipse, and adding to the deflecting field which gives the minor diameters a further deflecting field proportional to the high frequency voltage If the eccentricity of the ellipse be sufficient, the time base is substantially rectilinear and uniform Direction finding is demonstrated by Dr Smith-Rose, the currents produced in a rotatable coil by a neighbouring oscillator being read off from a galvanometer Possibly if a pointer were fixed to the coil with its tip moving over a set of equidistant straight lines forming a scale, the galvanometer reading could be adjusted to give directly the sine of the inclination of the coil to the wave front, as indicated by the tip of the pointer The General Electric Company illustrates in a striking way the problem of uneven filament-heating In a diode valve the filament heating current is an A C from the source that supplies the anode volts, but the phase of the filament current can be varied The brightest point on the filament is seen to move along the latter as the phase alters The longest electromagnetic wave-lengths are represented by some experiments on audio-frequency currents

Amongst the geophysical apparatus must be mentioned a working installation of the new Milne-Shaw seismograph, which employs an optical lever and Foucault-current damping This instrument is exceedingly sensitive, giving a magnification of 500, and can even indicate the tilt of a coast due to tidal load Records of the Japanese earthquake of September 1923 are exhibited

The biological exhibits include all those which proved most attractive last year together with some additions, amongst which may be mentioned Prof Groom's cultures of various species of fungus causing dry-rot in timber Prof Harris shows an apparatus for measuring the oxygen pressure of fresh blood, the blood and a comparison solution being contained in two quartz bottles which can be exposed to light containing ultra-violet radiation It is shown that exposure to light promotes the absorption of oxygen and so alters the equilibrium point between the oxygen in the blood sample and that in the air above it Dr E H J Schuster shows a respiration pump by means of which a detached organ or a headless trunk can be kept alive for some hours In connexion with physiological demonstrations it is perhaps well to remind the public that with a few rare exceptions British biologists have been humane men who have recognised the imperative duty of using anaesthetics in experiments on living animals In the physiological section is also classified an apparatus for measuring the compressional elasticity of films of fatty substances on water The water surface is swept clean and the film is compressed by means of a measured force applied to a floating strip The films are found to be monomolecular The method has been used for estimating very small amounts of fat

An attractive innovation is a miniature kinematographic projector by Kodak for which a number of scientific films have been obtained, including some high-speed films taken with the Heape and Grylls machine

The Exhibition as a whole is an admirably conceived attempt to instruct the public as to the methods and aims of science, and is entitled to the support of all who have the interests of scientific prestige at heart In conducting their unscientific friends through the series of demonstrations provided they will themselves derive no small profit and enjoyment C W H

Problems of the Rhone Delta [1]

By R D OLDHAM, F R S

III

THE eastern branch of the Rhone has undergone changes, as extensive and remarkable as those of the western, though differing in character In the early centuries of our era the mouth of the river is put, in the maritime itinerary of the Antonines, at 16 Roman miles from the port of Fossæ Marianæ, and from thence it was 30 miles by river to Arles These distances fix the mouth of the river close by the present termination of the Vieux Rhône, or main channel during the seventeenth century, and this identification is borne out by the finding, in 1883, of an old boundary pillar with a Latin inscription, regarded as fifth or sixth century, which appears to show that it was set up near to the mouth of the Rhone The place where it was found lies 3 km west of the old river channel and 2 km inland from the sea-face of the delta, and, whatever may be the exact age of this inscription, it must date from before the subsidence in the Dark Ages

This subsidence brought about great changes, a large part of the seaward portion of the delta was submerged, leaving numerous islands of various sizes, the memory of which is partially preserved in local place names, and the mouth of the river proper receded to near, but not up to, the town of Arles

When light again begins to dawn on the history of this region we find, in the description, by Roger de Hoveden, of the voyage of an English fleet along the coast in 1190, a statement that they passed an island called Odur, at the mouth of the Rhone, going up which river brings one to the fine city of Arles le Blanc The identification of this Odur is certain, it is known at the present day as the Roque de Dour, or more simply La

[1] Continued from p 19

Roque, a low hill of about 25 feet high, rising from the alluvium of the delta, just west of the entrance to the Etang de Galejon In the form of Odor or Dor it appears on all the portolan maps, being given equal prominence with other more conspicuous towns, ports or landmarks, and evidently owed this prominence to its importance as marking the entry to the main channel leading to Arles On a flat, low-lying coast, often indistinguishable in hazy weather, even so small a hill would form an important landmark

The course of this channel can still be traced, it was up the Étang de Galejon, and then westwards along the general course of an old river channel, known as the Bras Mort, to the neighbourhood of the village of Passon, on the banks of the Rhone Along this line there is a strip of low-lying modern alluvium, bordered on both sides by higher ground, part of the old land surface of the Roman period The Bras Mort was practicable for small boats, at any rate during part of the year, until it was artificially closed in 1642, but long before that it had ceased to be navigable by ships The channel was, however, still in use at the beginning of the fifteenth century, and is described in a portolan, or book of sailing directions, printed at Venice in 1490, evidently from old manuscripts works of similar character, dating from the early part of the century

The advance of the mouth of the river and successive closing of alternative channels of access to the town and port of Arles can be traced in the records of that city From the commencement of the Middle Ages it claimed, and exercised, a control over the navigation of the Rhone, and, for the purpose of this control, maintained an armed and fortified post for the double purpose of levying tolls on the shipping and excluding undesirable, or piratical, intruders The latter purpose made it desirable that the post should be as distant as possible from Arles itself, the former compelled it to be situated so near that the traffic had to pass it, that is to say, above the highest point where there was an alternative channel to the open sea The earliest of these fortified posts or towers of which there is record was the Tour de Malusclat, the exact position of this has not been identified, but the name remains as that of a village, and it must have been on the western bank of the river a couple of miles or so above Passon, the place where the old channel from the Galejon joined what is now the main stream of the Rhone The date of construction of this tower is not known, but, about the middle of the fifteenth century, the advance of the mouth of the river having reached the neighbourhood of Passon, the channel leading to the Etang de Galejon, and the Roque de Dour, became blocked by the alluvial deposits of the river, thereby closing what had been the principal channel of access This made the situation of Tour de Malusclat no longer suitable, and, in 1469, the Council of Arles decided that it should be demolished and a new tower built farther down the channel

The site of this new tower, afterwards known as the Tour de Belvar or Bolovard, has been identified, in the lands of the Grand Peloux, close to the left bank of the present channel, and nearly opposite where the Bras de Fer channel takes off from the river It was not, as has been stated in some modern works, built on the actual sea-face of the delta, for maps of the seventeenth century, and records of law suits and grants of land in the thirteenth, show that there was land to the southwards, but the site was chosen because it lay at the junction of two alternative channels of access, and was the site, farthest from the city of Arles, at which the whole traffic of the river could be controlled by a single post It remained in function for more than a century, during which the principal channel led southwards,

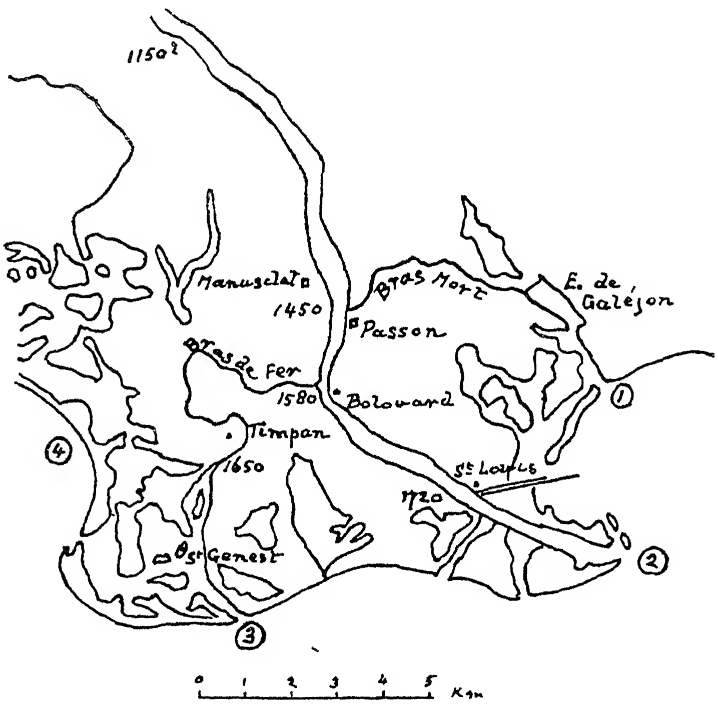

FIG 4 —Lower course and mouth of the Rhone showing position of the successive towers approximate position of the mouth of the river at the date indicated and main channels of navigation (1) Up to about 1450 (2) Until 1585 and again from 1720 to the present day (3) From about 1585 to 1720 (4) Alternative channel finally blocked about 1650

much along the general course of the existing river channel By 1587 the mouth of the river proper had advanced to this place, and the river, instead of continuing along the direct channel, broke away to the westwards, to follow the general course of the Bras de Fer

The Tour de Bolovard was thus left stranded and, after a while, sold and demolished, all but the foundations, which still remain Meanwhile, a new tower had been built, in 1607, known as the Tour de Tampan, on the banks of the Vieux Rhône and about 8 km inland from the present coast-line Here, again, the tower was not built on the sea-face, for old maps show that a group of islands, separated by channels, extended out to very near the existing sea-face of the delta, the site was evidently selected because, in addition to the channel afterwards followed by the river, there was another navigable channel, called the Rajeirol, which led, from a little below the tower, into the Golfe de Beauduc

In course of time the river mouth passed this channel and blocked it up, so the Tour de Tampan was abandoned and a new one, the Tour de St Genest, was built, in 1656, on what was evidently an island of the old land surface of Roman times, and not far from the spot where the boundary stone with Latin inscription was discovered in 1883

This tower, at last, lay close to the sea-face of the delta, the most advanced outpost of the old land was not much more than a mile to the southwards, and, when the river extended past this point, it no longer ended in a sheltered inlet, but in the open sea The formation of an extension of the delta, by the silt brought down the river, began, and a difficult and dangerous bar developed, the hindrance to navigation becoming more acute as the river mouth was pushed farther out into the open sea Many schemes and proposals for remedying this were considered, during the latter half of the seventeenth century, but none had been initiated when, in 1711, the river broke away along the line of the old navigable channel, past the site of the Tour de Bolovard, to enter the sea close by the place where, in 1737, the Tour St Louis was built, close to the sea-face of the land, as it then stood Since then there has been no further change in the channels farther up-stream, and the whole river is so firmly controlled by protective embankments that none is likely to occur

From this brief history it appears that the mouth of the Rhone, which was near Passon about the middle of the fifteenth century, had advanced to the present coast-line at the Vieux Rhône by the middle of the seventeenth, and early in the following century was at the coast-line of that time near the modern town of St Louis This advance of the mouth of the river does not, however, mean a growth of the delta by a depth of ten kilometres along a breadth of about twenty, this would mean an increase of nearly a square kilometre a year, fully five times the rate of growth of the delta during the last two centuries It was, however, not from the open sea that the land was reclaimed, but from a number of shallow channels separating islands of old alluvium, thus reducing largely both the area and depth of the new deposits, and in this way the changes, which are known to have taken place, are not merely to be explained by subsidence of the land during the Dark Ages, but in themselves become evidence of the reality of the change of level, independently deduced from evidence of a wholly different character

(To be continued)

Two New Elements of the Manganese Group

THE recent discovery of the two missing elements of the manganese group by Dr Noddack and Fraulein Tacke of Berlin is of interest not only as an important step towards the completion of the periodic table but also on account of the methods used in the research In these days no one branch of science can afford to stand aloof from the others, and perhaps it would be difficult to find a happier example of the way in which the various sciences can combine towards a successful result than this discovery of the eka-manganeses Chemistry, physics and mineralogy have all played their parts, and the result is that the number of gaps between hydrogen and uranium in the periodic table has been reduced from five to three

In the preliminary account of their work which has been published in *Die Naturwissenschaften* for June 26, p 567, the authors give, in addition to the results of their investigations, the arguments on which their line of attack was based In the first place, it was necessary to find some material in which the new elements might reasonably be expected to occur A study of the neighbouring elements suggested two possible sources, the first that of the platinum ores, the second a mineral such as columbite The platinum ores contain the elements chromium to copper, ruthenium to silver, osmium to gold, or, expressed in atomic numbers, 24 to 29, 44 to 47, and 76 to 79 Columbite, on the other hand, contains, among many other elements, those of atomic number 39 to 42 and 71 to 74 Here, therefore, were two minerals in either of which the missing elements 43 and 75 might well be found

In endeavouring to form an estimate of the amounts of the elements 43 and 75 which might be present in these minerals, the authors employed an ingenious argument The constitution of the earth's crust is now fairly well known, and it is possible to assign to the various elements numbers indicating the frequency of their occurrence A study of these figures indicates that elements of odd atomic number are less common than those of even atomic number, in fact an odd element is ten or twenty times less abundant than the succeeding even element As ruthenium (44) and osmium (76) constitute about 2×10^{-12} and 2×10^{-11} of the earth's crust, it was deduced that the elements 43 and 75 would form about 10^{-13} and 10^{-12} of the earth's outer layer As the frequency of occurrence of platinum is 10^{-9}, the amount of the elements 43 and 75 in the platinum ores should be from 10^{-3} to 10^{-4}, and as niobium, one of the chief constituents of columbite, forms 10^{-7} of the earth's surface, columbite was estimated to contain from 10^{-5} to 10^{-6} of the missing elements In this way Drs Noddack and Tacke obtained some idea of the extent to which the chemical processes of extraction would have to be carried if measurable quantities of the new substances were to be obtained

It was a fairly straightforward matter to predict some of the chemical properties of the new elements from a consideration of their neighbours in the periodic table Thus it appeared probable that both would form oxides X_2O_7, and that these oxides would readily sublime on account of the small difference of temperature between their melting- and boiling-points Again, for example, it was argued that the eka-manganeses would resemble chromium in so far as no sulphides would be formed from aqueous solutions These and other chemical properties were used in the chemical treatment of the ores

Attention was first directed to the platinum ores as offering the highest chance of success After preliminary chemical treatment, the residue of 80 gm of a Russian ore was strongly heated alternately in oxygen and hydrogen Among the deposits on the walls of the vessel was found a very small quantity of white microscopic needle crystals These needles became dark in

colour when treated with a stream of hydrogen sulphide, while a subsequent heating in oxygen resulted in the reappearance of the white sublimation product on the colder part of the vessel. An aqueous solution of these crystals gave no precipitate either with hydrogen sulphide or ammonium sulphide. As such behaviour was to be expected from the elements 43 and 75 and from none of the other known elements in the solution, it was presumed that this substance contained the missing elements. Further attempts at concentration resulted in a loss of the material.

Through lack of further supplies of the platinum ores, the authors turned their attention to columbite, resolving at the same time to carry out the final analysis by X-rays. From about 1 kgm. of the mineral the greater part of the iron, niobium and tantalum was removed by sodium hydroxide and sodium nitrate; the filtered solution was treated with hydrogen sulphide and concentrated to a volume of 50 c.c. By the use of mercurous nitrate, about one gram of precipitate was obtained from this solution. A repetition of the process gave about 50 mgm., estimated to contain about 5 per cent. of the elements 43 and 75. Heating in oxygen gave once more the white sublimate. The quantity available was too small for direct application to the anticathode of the X-ray tube. It was, therefore, mixed with niobic acid and examined spectroscopically in this form.

X-ray spectra probably provide the best method for the detection of a small quantity (say 0.1 per cent.) of an element in a mixture. These spectra are much simpler in nature than the optical spectra, and, unlike the latter, do not depend on the mode of excitation or on the state of chemical combination. The wave-lengths are determined by the atomic number alone. From Moseley's laws it is possible to predict the wave-lengths of the various lines with considerable accuracy. A further check is provided by an examination of the relative intensities of the lines. An X-ray investigation of the final products of the chemical processes was carried out by Drs. Berg and Tacke, and a search made for the K series of the element 43 and for the L series of 75. The result was entirely successful. Three lines appeared on the plates corresponding to wave-lengths 0.601, 0.672 and 0.675 Å.U., whereas the calculated values of the $K\beta_1$, $K\alpha_1$ and $K\alpha_2$ lines for an element 43 are 0.600, 0.673 and 0.678 Å.U. These are the three strong lines in the K series, and their relative intensities agreed with the well-known ratios. In the spectral region 1.20 to 1.43 Å.U. there occurred five lines which were identified as the $L\alpha_1$, $L\alpha_2$, $L\beta_1$, $L\beta_2$ and $L\beta_3$ lines of an element of atomic number 75. The numerical agreement was excellent; thus, the observed and calculated wave-lengths of the $L\alpha_1$ line were 1.4299 and 1.4306 Å.U. There is always a chance that the lines may be wrongly identified, but the authors appear to have taken due precautions against any possible misinterpretation, and there seems no doubt that these lines are actually due to the presence in the columbite residue of the elements 43 and 75.

As a result of this careful research work, the existence on the earth of the elements of atomic number 43 and 75 appears to be definitely established, a fact which is all the more interesting because certain writers have put forward arguments suggesting that a search for the eka-manganeses must prove fruitless. The actual amount of the new elements in columbite is estimated as from 10^{-6} to 10^{-7}, or somewhat less than the proportion indicated by the calculations outlined above. The chemical and physical properties appear to be closely related to those predicted by an examination of their neighbours, but no doubt more details will soon be available when greater quantities of the new elements have been isolated.

The authors suggest that the two newly discovered elements should be named Masurium (Ma) and Rhenium (Re) after the district of Eastern Prussia and after the Rhine respectively. Whether these names will meet with such widespread approval as the research itself remains to be seen.

Current Topics and Events

IN celebration of the 250th anniversary of the foundation of the Royal Observatory, Greenwich, their Majesties the King and Queen will pay a visit to the Observatory on July 23. We understand that they will be received in the Octagon Room, the original Observatory, by members of the Board of Admiralty and of the Board of Visitors of the Royal Observatory, and will then be conducted over the buildings and shown the principal instruments. On the evening of the same day a conversazione is being given by the president and council of the Royal Society to meet the delegates to the International Astronomical Union. On the following day an official luncheon is being given, presided over by the First Lord of the Admiralty.

AFTER nearly two years' effort, the Australian National Research Council has succeeded in its project for establishing a Commonwealth School of Anthropology, to be attached to the University of Sydney. In December 1923 the Commonwealth Government expressed approval of a scheme submitted to it: in the following year, however, an officer selected by the British Government to advise Australia in the matter of administration of Territories reported very strongly against the proposal to use such a school for the training of officials. In consequence, Government interest flagged. Renewed efforts, supported by the Australasian Association for the Advancement of Science and the universities, were made in September, and, largely as the result of a visit from Prof. Elliot Smith, who brought unofficial word of warm American sympathy, the Prime Minister promised to provide 1000*l.* per annum towards the expenses of a chair. The estimated yearly requirement being 2500*l.*, the respective States were then asked to contribute the balance of 1500*l.* between them on a population basis. New South Wales, Victoria, Queensland and Tasmania agreed to provide their shares, and South Australia is practically certain to fall into line; Western Australia remains uncertain. The Research Council, therefore, has now asked the Senate of the University of Sydney to consider the immediate appointment of a professor

and the general arrangements for the new school In doing so, it has laid emphasis on the following points (*a*) The main work of the chair both in teaching and research should be in the field of social anthropology rather than on the physical or anatomical side, though provision should be made for this also (*b*) In view of the training of students for Government service in Papua and the Mandated Territories and for specialised work in the Pacific, the professor chosen should have had actual field experience (*c*) Though the routine work of the new chair will be under the control of the University of Sydney, it is urged that a permanent Advisory Committee, containing representatives of the Commonwealth, States and Research Council, should be appointed, to assist in the organisation of field research

An international conference is shortly to be held at The Hague on the subject of industrial property, that is to say, on patents, trade marks, and designs It is a matter of considerable importance that Great Britain should be represented by delegates who have had wide experience in patent practice, but if the conference held in 1922 on the proposed Empire patent is to be taken as a precedent, it may be gravely doubted whether any such precaution will be taken It will be remembered that at that conference the Comptroller was accompanied only by representatives of the clerical staff of the Patent Office, to the exclusion of representatives of the scientific staff who would have possessed both legal and technical training and experience It is not surprising, in these circumstances, that the conference failed to produce any result, for the very delicate technical question arose of an Empire "search," or examination of all relevant British Empire patent specifications, before granting a patent, and none of the British representatives had that direct acquaintance with the 'search" which might have enabled them to deal with this thorny problem in such a way as to satisfy the *amour propre* of the Dominion Governments It would be far more serious, however, if Great Britain were to be unsuitably represented at an international conference, particularly if the Comptroller should be unable to attend in person The effect of a given change in international patent practice cannot be instantly grasped by any one who lacks extensive experience of patents and the interests of British manufacturers may inadvertently be prejudiced by negotiators who are not adequately qualified for their work We trust that, on the occasion of the impending international conference, full use will be made of the technical knowledge and experience of the Patent Office staff

The Santa Barbara earthquakes at the end of last month prove to have been of less importance than the early accounts suggested By the first, on June 29 at about 6 30 A M (2 30 P M , G M T), many buildings in Santa Barbara were destroyed or damaged (the loss being estimated at from three to six million pounds), twelve persons were killed, and water-mains were broken The second, on June 30 at 1 22 A M , is said to have equalled its predecessor in strength, while one of the after-shocks, on June 30 at 4 42 A M , is described as severe The area affected by the earthquakes was apparently small, and this seems to indicate that the depth of the foci was comparatively slight In the neighbourhood of Santa Barbara there are several faults running east and west or parallel to the trend of the coast-line, and traversing longitudinally the Santa Inez and San Gabriel mountains In the fault-map of California, issued by the Seismological Society of America, they are shown as inactive, but it would seem that they are rather in a state of moderate activity at long intervals To one or more of these faults Dr Bailey Willis attributes the group of strong earthquakes on November 27-30, 1852, and a local earthquake on July 30, 1902 (Bull Seis Soc America, vol 14, 1924, pp 18-19) Between these shocks, on January 9, 1857, an earthquake, stronger than any of those mentioned above, was felt generally throughout southern California and severely in the Santa Barbara district Dr Willis assigns its origin to a movement along the extensive San Andreas fault, that with which the San Francisco earthquake of 1906 was connected

A preliminary report on the Canadian earthquake of February 28 (Nature, March 7, vol 115, p 347) has been issued by the seismologist of the Dominion Observatory (*Science*, vol 61, 1925, p 584) The epicentre of the earthquake is supposed to be in the mountainous region near the eastern boundary of the Laurentide Park Its exact position is, however, at present unknown, the region being inaccessible when the first investigation of the central area was made Many of the reports of the damage proved to be exaggerated or erroneous, but the amount was considerable at Quebec, Shawinigan Falls, Malbaie, St Urbain, and the district near the Riviere Quelle In every case of serious damage the ground was sand or clay, usually on the side of a hill, and the buildings were massive stone structures, without steel reinforcement, such as churches A new seismograph station (the sixth in the Dominion) has been established by the Department of the Interior at Ste Anne de la Pocatiere near the centre of the area affected by the earthquake of February 28

June established a record for its dryness, and almost a record for its duration of bright sunshine in England At the Royal Observatory, Greenwich, according to the weather records published by the Registrar-General in the Weekly Return of Births and Deaths, rain fell only on two days the measurements being 0 11 in on June 24, and 0 01 in on June 26, making a total of 0 12 in for the month The previous minimum rainfall at Greenwich in June since 1815, in 110 years, was in 1895 and was 0 21 in The normal for 100 years to 1915 is 1 99 in , the normal for 35 years, 1881 to 1915, is 2 02 in , and the normal days with rain, 11 The smallest rainfall in any month of the year was in February 1821 and was 0 04 in , and in comparatively recent years, since 1900, the smallest monthly total was in April 1912 (0 07 in), and in February 1921 (0 12 in) There

was a drought from June 1 until 23. According to the weather correspondent of the *Times* (July 1), June 1925 was the driest June at Kew since records started in 1871, and also the sunniest. The total rain at Kew was 0.04 in. Ross-on-Wye, Calshot (near Southampton), and Falmouth are reported to have had no rain. The duration of bright sunshine at Greenwich was 251 hours, which averages 8.36 hours per day. In June 1914 the sun shone for 267 hours, which is 16 hours more than in June this year. The average duration in June for the 35 years 1881 to 1915 is 201 hours, 6.70 hours per day. The mean maximum shade temperature at Greenwich was 73° 1 F., which is 3° 1 above the normal, and the mean minimum was 49° 7 F., which is in precise agreement with the normal; the excess of heat was clearly due to the intense sunshine in the early part of the month.

WE learn from *Science* that Dr. E. L. Thorndike, professor of educational psychology in Teachers College, Columbia University, has been awarded the Butler gold medal, given every five years by Columbia University for the most distinguished contribution to philosophy or to educational theory, practice or administration, for his contribution to the general problem of the measurement of human faculty and to the application of such measures to education.

THE third annual corporate meeting of the Institution of Chemical Engineering is to be held in the Philosophical Hall, Leeds, on July 17. Afterwards a joint meeting will be held with the American Institute of Chemical Engineers, at which addresses will be delivered by the presidents of the two bodies, Sir Arthur Duckham and Dr. Charles L. Reese; and a symposium on "Industrial Water Supply and Stream Pollution" will be presented. Visits to Messrs. Nobel Industries, Ltd., Messrs. Jos. Crosfield and Sons, Ltd., and the United Alkali Co., Ltd., and to various places of interest in Scotland and England, have been arranged to follow the meeting.

MR. T. R. FERENS, of Hull, is well known for his generous gifts for educational purposes culminating in a gift of 250,000*l.* for a university college at Hull, referred to in our issue of February 14, p. 239. He has now presented a sum of 20,000*l.* to the Medical School of the Middlesex Hospital for the foundation of an Institute of Otology. The new institute, which will occupy for the present a part of the top floor of premises in Cleveland Street, to which patients from the Middlesex Hospital are being removed during rebuilding of the Hospital, will be devoted to research on the structure, functions, and diseases of the ear, nose, and throat, and it is intended to establish a laboratory, museum, and library.

PROF. R. RUGGLES GATES, professor of botany, University of London (King's College), is sailing from Liverpool on July 14, by the S.S. *Hildebrand*, on an expedition to the Amazon region. He will leave the ship at Manaos and spend a month collecting plant materials in that region and farther down the river. Returning from Para, he will reach England early in October. Prof. Gates is taking Wardian cases to bring back living plants, and will also collect cytological and morphological material for research, as well as some dried specimens. He is also taking a photographic outfit, including a cinema camera and 3000 feet of film, and he expects to make some collections of plankton during the voyage and on the river.

THE control of the administration and the management of the Imperial Institute, South Kensington, has now been transferred, in accordance with the provisions of the Imperial Institute Act, 1925, from the Secretary of State for the Colonies to the Parliamentary Secretary, Department of Overseas Trade. The Imperial Mineral Resources Bureau was amalgamated with the Imperial Institute at the same time, and all correspondence relating to the work of the Bureau should be addressed to the Imperial Institute (Mineral Resources Department), South Kensington, London, S.W.7.

AT the time of going to press (July 8), a reception is being held in the Pavilion of His Majesty's Government at the British Empire Exhibition, and invitations have been issued to view the Science Exhibition arranged by a committee of the Royal Society. The guests are being received by the president of the Royal Society, Sir Charles Sherrington, and the chairman of the Committee organising the exhibits, Mr. F. E. Smith. The Exhibition this year is a decided advance on that of last year, as will be seen from the account indicating some of its main features which appears elsewhere in this issue (p. 50). The Committee responsible for it is to be congratulated on the very representative collection of demonstrations and exhibits brought together. In connexion with the Science Exhibition, a volume entitled "Phases of Modern Science" has been prepared; this includes articles by leading authorities on various aspects of modern scientific research, and a descriptive catalogue of the exhibits. It constitutes a most valuable statement of the present position of physical and biological science. The section describing the exhibits is also being issued separately and is obtainable in the Government Pavilion at Wembley.

THE ninety-third annual meeting of the British Medical Association will be held at Bath on July 21-24, under the presidency of Dr. F. G. Thomson, physician at the Royal United Hospital, Bath. The annual representative meeting of the Association will be on July 17-20. The president will deliver his address and also open the annual exhibition of surgical appliances, foods, drugs, and books on July 21. Sir William Bragg is to deliver a popular lecture during the evening of July 24. The provisional sectional programmes include discussions on the following subjects, the opener's name appearing in brackets after the subject: Endocrine therapy (Dr. W. Langdon Brown and Prof. Swale Vincent); filter-passing viruses (Dr. W. E. Gye); pathological basis of treatment by radiation (Prof. S. Russ), pathology and bacteriology in Great Britain with special reference to research (Prof. J. C. G. Ledingham), therapeutic value of light

(Prof W E Dixon), food manipulation and health (Dr W G Savage), influence of sunlight and artificial light on health (Prof L Hill), and the purity standard of milk (Dr R Stenhouse Williams, Dr W G Savage, Dr E Pritchard, Mr W Buckley, Mr G P Male and Mr J H Maggs, each discussing a different aspect) The honorary local general secretary for the meeting is Mr W G Mumford (British Medical Association Committee Rooms, Assembly Rooms, Bath), and the honorary assistant secretary is Dr R G Gordon

DR ALES HRDLIČKA, of Washington, is now travelling through India on the first stage of a survey of the field of early man and his predecessors in southern Asia, Australia, and Africa, on behalf of the Smithsonian Institution and the Buffalo Society of Natural Science In the course of a letter to the former body, he has some interesting observations to make on what he had seen up to the time of writing Of the physical character of the people he says that the main elements are unquestionably Mediterranean and Semitic, but there are also indications of a Hamitic mixture He had intended to visit Karachi to investigate the curly-haired people there, but considered this unnecessary, as he was informed that they were known to be of African importation, and that if there were any such natives they must be somewhere at the head of the Persian Gulf, a region now impracticable to reach At Simla he saw peop e from the Tibetan borders and some few even from Tibet Among the latter was one woman who looked a typical American Indian, her dress also strongly suggested the Indian

THE hundredth annual report of the Bath Royal Literary and Scientific Institution records an earnest effort on the part of the members to revive its interest and usefulness The ceiling paintings by Andrea Casali have been cleaned, the valuable collection of birds put into good order and the various rooms redecorated The famous geological collection, containing 27 teeth of *Microlestes moorei* and 70,000 fish teeth from fissures of Rhætic age in the Carboniferous Limestone, is being re-arranged and relabelled as a memorial of the labours of Charles Moore, who did so much for the Museum and for geology The winter series of lectures interrupted by the War were recommenced in 1921-2, and have steadily increased in number and interest until the accommodation is insufficient A project for widening the adjoining roadway may result in the present building being taken down, in which case it is to be hoped that the Society may find itself provided with sufficient funds and vigour for the provision of a more suitable and better-placed museum in which the collections can be better displayed

THE May issue of the *Scientific American* inaugurates a discussion as to whether street accidents due to careless driving would be diminished by the substitution of a regulation as to the distance in which a vehicle should be able to stop for the present speed limit Mr H W Slauson, who opens the discussion, is of opinion that they would, and points out that the object of the speed limit is to ensure that the driver shall have his vehicle under such control that he can stop quickly when called upon to do so He may be under the speed limit, but his physical and mental condition and the state of his brakes may be such that he cannot stop quickly enough to avert an accident under the speed limit regulation he is blameless The fault lies with the regulating authority Under a stopping-distance regulation, the duty of adjusting the speed to the condition of the driver and his vehicle would rest on the driver Roads would be specified as "twenty feet," "fifty feet," etc, and the tests of vehicles would be simpler than the present speed tests

THE Report of the Castle Museum, Norwich, for 1924, records a large number of gifts, and among them a fine series of mounted heads and horns of big game bequeathed by the late Mr E N Buxton To accommodate these, as well as the many previously in the Museum, it is proposed to extend the building over a portion of the inner garden It has also proved necessary to extend the Skin-Room over a vacant space enclosed by the outer wall of the Castle A large collection of flint implements from various local sites, presented by Mr H H Halls, has been drawn upon, with others, to provide a case illustrating neolithic culture in Norfolk and Suffolk In many other directions, not so directly within our scope, this Report bears witness to a progress and activity of which Norwich should be proud

SOCIETIES and Institutions in Great Britain, desiring to get into touch with similar bodies in Russia for the purpose of exchange or purchase of recent scientific publications, should address correspondence on the subject to one of the following organisations, in the hands of which the government of the U S S R has placed the responsibility for all arrangements of the kind For all societies and institutions in Leningrad The Publications Exchange Department, The Academy of Sciences, Leningrad For all those in the whole of the rest of Russia, and for those in other constituent territories of the Union of Socialist Soviet Republics The Book Exchange Bureau, The U S S R Society for Cultural Relations with Foreign Countries, Sverdlov Place, Moscow

DR C A CROMMELIN has published the inaugural lecture delivered by him on May 12 on the occasion of his taking up the post of lecturer in physics at the University of Leyden (Leyden Edward Ijdo) As is well known, Dr Crommelin has collaborated with Prof Kamerlingh Onnes for many years in the conduct of the experimental researches carried out at the famous Physics Laboratory of Leyden In all that relates to the science and art of measuring pressures, temperatures and volumes, he is one of the most experienced physicists in Europe, and now that Prof Kamerlingh Onnes has retired, there is perhaps no one in the world who possesses the same knowledge of the intricate technique required in the measurements at low temperatures and high pressures which characterises so much of the work done at Leyden In his address Dr Crommelin has given a most interesting historical sketch of the development in the

making and using of instruments and apparatus in connexion with experimental research in physics It is illustrated with portraits of three members of the celebrated van Musschenbroek family and is fully documented with literature references For many years the laboratory of Kamerlingh Onnes has been a famous training school for young instrument makers and glass-blowers Perhaps nowhere else in the world has so much attention been given to the development of this side of the work which is required in a great laboratory of experimental research in physics It is therefore particularly appropriate that Dr Crommelin should deal with this subject in his inaugural address, which can be heartily recommended to all who take an interest in the history of physical experimentation

In the Report of the Rhodesia Museum, Bulawayo, for 1924, the curator, Dr G Arnold, records the finding of several palæoliths from an ancient land surface now covered by 15-20 feet of flood-silt from the Umgusa River He believes ' that these implements, mostly of a Chellean and Acheulian facies, were fashioned by the predecessors and contemporaries of Broken Hill Man "

Applications are invited for the following appointments, on or before the dates mentioned A part-time research demonstrator in mathematics at University College, Swansea—The Registrar, University College, Singleton Park, Swansea (July 15) Museum assistant and demonstrator in zoology at Birkbeck College—The Secretary, Birkbeck College, Fetter Lane, E C 4 (July 21) Professor of electrotechnics in University of the Witwatersrand, Johannesburg—Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, W C 2 (July 31) Five appointments in the School of Dental Surgery Cairo, namely, superintendent and lecturer in metallurgy and materia medica lecturer in surgery and pathology, assistant lecturer in surgery and pathology, lecturer in mechanics and orthodontia, and a mechanic —The Under-Secretary of State Ministry of Education, Cairo (August 14) Professor of organic chemistry and director of the chemistry department, Armstrong College Newcastle-upon-Tyne—The Registrar (August 15) Director of the Rubber Research Institute in the Malay States—The Private Secretary (Appointments), Colonial Office, 38 Old Queen Street, Westminster, S W 1 (August 31) A reader in biology in the University of Hongkong — The Chief Medical Officer, Ministry of Health, Whitehall, S W 1 (September 1) Professor of public health in the University of Edinburgh—The Secretary (September 15) Laboratory assistant for the Mobile Unit, Government Laboratory, Gold Coast — Crown Agents for the Colonies, 4 Millbank, Westminster, S W 1

Our Astronomical Column

Discovery of a Tenth Magnitude Object —A telegram from the International Astronomical Union Bureau, Copenhagen, announces the discovery of an object of the tenth magnitude Its position on June 28 at $1^h\ 37\ 0^m$ G M T (new) was R A $0^h\ 23^m\ 28^s$, N Decl 0° 41′ Daily motion $+1^m\ 48^s$, N 14′ The motion is rather large for a minor planet, unless it should be of the Eros type

M Delporte apparently took the plate in the search for Tempel-Swift's periodic comet, using the ephemeris in the British Astronomical Association Handbook However, as a later examination makes the probable date of perihelion March 1926 (see B A A Journ , vol 35, p 159), the object is not likely to be identical with that comet No further observations are to hand at the time of writing

The Royal Observatory, Greenwich —Dr J L E Dreyer contributes an article to the *Nineteenth Century* for July, which summarises the work done at Greenwich during the 250 years of its existence, and emphasises the vagueness of the knowledge of the heavens that existed at the time of its foundation Tycho Brahe's star catalogue was then the best available, and the best lunar tables differed a quarter of a degree or more from the heavens Flamsteed's observations of the moon were of great assistance to Newton for comparison with his gravitational theory Dr Dreyer vindicates Flamsteed against the charge of withholding these observations from Newton

The splendid work of Bradley is given due prominence, credit being also given to Bessel and Auwers, who brought the results into a form that later astronomers could utilise The development of the work of the Observatory under Airy and the further extensions made since his time are also described

Dr Dreyer is well known as an astronomical historian, and he has a congenial subject in dealing with the remarkable advance in knowledge since 1675, in which Greenwich has played a considerable part

The Physical State of the Stars —While insisting on the incompleteness of the available observational material, Dr A Brill, in the *Zeitschrift fur Physik* of March 21, attempts to deduce, on the basis of the Eddington theory, general regularities in the connexion between spectral type, surface temperature as deduced from colour and from energy distribution in the spectrum, absolute brightness mass and other physical magnitudes for a very large number of dwarf and giant stars It was found that the logarithm of K, Eddington's constant which determines the mass absorption coefficient k in the interior of a star, only varies from 27 41 to 27 69 between the different spectral classes $k\sqrt{\epsilon}$ is nearly constant for all stars, where ϵ is the energy radiated in unit time per gram The following table, abridged from that in the original paper, gives some of the results obtained Super giants are not considered

Spectral Class	Temp °C	M(vis)	R cm	Mass gm	g cm /sec²	ρ gm /cm³
Dwarfs						
O	28 7 × 10³	− 4 00	711 × 10⁹	738 × 10³²	9 70 × 10³	4 9 × 10²
B_0	21 4 ,,	− 1 30	241 ,,	154 ,,	17 7	2 6 × 10¹
A_0	11 8 ,,	+ 0 90	170 ,	54 7 ,,	12 6	2 7 × 10¹
F_0	7 76 ,,	+ 2 65	143 ,,	32 2 ,	10 5 ,,	2 7 × 10¹
G_0	6 32 ,	+ 4 50	90 8 ,,	21 3 ,,	17 2 ,,	6 8 × 10¹
K_0	5 23 ,,	+ 6 35	59 7 ,	15 1 ,	28 1 ,,	1 7
M_0	3 79	+11 00	19 2 ,,	6 89 ,,	124 ,,	23
Giants						
G_5	4 98 ,,	+0 25	1150 ,,	79 1	0 399 ,	1 2 × 10³
K_0	4 57 ,,	+1 55	824 ,	56 0 ,,	0 548 ,	2 4 × 10³
K_5	3 62 ,	+0 75	2550 ,,	99 5 ,,	0 102 ,,	1 4 × 10⁴
M_0	3 52 ,,	+0 25	3150 ,,	112 ,,	0 0757 ,,	8 7 × 10⁵

M(vis) is the visual absolute brightness in magnitudes R the radius, g the gravitational acceleration at the surface and ρ the density

Research Items

THE ETHNOLOGY OF THE FINNO UGRIANS —Dr U T Sirelius has published through the Government Printing Office, Helsingfors, a study of the history culture, linguistic and physical characters of the Finno-Ugrian peoples under the title "The Genealogy of the Finns" Although it is clear from the concluding chapter, which advocates political independence for those members of the group who have not already attained it, that the pamphlet is a piece of political propaganda it is nevertheless a useful review of the evidence bearing upon Finno-Ugrian affinities and early history No comprehensive survey of the physical characters of the Finno-Ugrians has been made, but such available data as are comparable indicate considerable divergence and show that they are no longer even approximately a homogeneous race They fall into two main groups, one short, comprising Lapps, Ostyaks, and Voguls, all living near the Polar Circle, and a tall group to which belong all the other peoples, Hungarians, Baltic Finns, Volga Finns, and Permians The Samoyeds, whose linguistic kinship to the Finns is now clear, resemble the members of the former group In culture also there is a division between the Lapps, the Seryenians of Archangel, the Voguls and Ostyaks, belonging to the north, who live by hunting, fishing or reindeer breeding, and the remainder, who are tillers of the soil

PERFORMANCE TESTS OF INTELLIGENCE —Report No 31 of the Industrial Fatigue Research Board, prepared by Miss Frances Gaw, describes performance tests of intelligence Most of the well-known intelligence tests have a decided bias towards linguistic ability, and although for many activities of life language is a necessary medium, yet in dealing with some types, *e g* the deaf, the blind, it is necessary to find some other way of measuring intelligence In the United States, owing to the large population of non-English-speaking foreigners, the study of performance tests has aroused much more interest than in England This report discusses the need for them, their historical development, the principal scales and uses, and describes a series of performance tests A comparison of these tests with other estimates of intelligence and with tests of mechanical and constructive ability is given, and there is a useful bibliography All those interested in intelligence testing will find these tests a useful supplement to the usual ones, and particularly valuable in the case of those children who tend to express themselves in other than linguistic modes

JAPANESE ALGÆ AND FUNGI —Dr Hans Molisch, professor of plant physiology in the University of Vienna, has been travelling for a considerable time in Japan, and Volume 1, No 2 of the Science Reports of the Tohoku Imperial University (Fourth Series), Biology, is composed entirely of various notes contributed by him upon his observations whilst in Japan Dr Molisch finds the same organism, *Bacterium phosphoreum* (Cohn), responsible for the development of luminosity in butcher's meat in Japan, if this flesh is kept standing in 3 per cent sodium chloride solution, but not submerged in the solution He describes curious fusiform bodies in a Japanese species of Vaucheria, which from their reactions appeared to be protein in nature He records the occurrence of a parasitic Alga, *Mycoidea parasitica* Cunningham, upon leaves of Camellia, and of an epiphyllous Alga, *Phycopeltis epiphyton* Millardet, upon the leaves of various evergreens in Japan *Pseudoplasmodium aurantiacum* Molisch is described and figured as the species of a new genus of Acrasieæ Various fungi are described with the habit of growing in and feeding upon the waxy deposits on the cuticles of many species of grasses, of Acer, and of other trees Some of these fungi were also grown in culture on beeswax Prof Molisch also supplies considerable data upon various organisms responsible for the deposition of hydrated oxides of iron in Japan a subject on which he has already published a monograph based upon his European studies He also records Nostoc colonies living apparently in symbiosis with two different liverworts, *Blasia pusilla*, L , and *Cavicularia densa*, St

EFFECT OF THYROID FEEDING ON FOWL PLUMAGE —Torrey and Horning (1922) reported that when dried thyroid was given to growing males these assumed hen-feathering Crew and Huxley (1923), repeating this work, but with different material and methods, failed to obtain confirmatory results However, it was noticed during the course of this work that the administration of thyroid was followed by a marked increase in the rate of plumage growth and replacement, and that in the birds used, Rhode Island Red (red ground with black areas) and Light Sussex (white ground with black areas), the birds receiving thyroid exhibited a pronounced tendency towards increased melanism, the black areas being markedly increased in size and intensity at the expense of the other colours Since it is known that such a parti-coloured bird tends to become lighter as it ages, the suggestion presents itself that in senility the thyroid of the fowl becomes relatively less efficient in its functioning Moreover, the observation that thyroid administration increased the rate of feathering in the growing chick and moulting adult gained in significance when Serebrowsky (1922), and more recently Warren (1925), showed that quick feathering as contrasted with slow is a typical sex-linked character One who seeks to interpret genetic action in terms physiological is attracted by the notion that this sex-linked factor in its action determines the time during development when first the thyroid comes into action or the degree of the functioning of this gland Cole and Reid (*Journ Agric Res*, 29 6, 285-287, 1924) also have recently repeated the work of Torrey and Horning and have obtained results which show beyond all doubt that thyroid administration does indeed affect the plumage characters of the male They found that new feathers grown by the birds receiving desiccated thyroid showed distinct modification towards the female type of structure and colour and that the rate of growth of these new feathers was noticeably increased There was a reduction of red pigment, the distribution of which was irregular, and also a reduction of that area of the feather in which the barbs lack barbules, the feathers of the hackle regions, instead of being pointed and elongate, coming to possess broad rounded ends closely resembling the feathers of these regions in the female

THE GEOGRAPHICAL RANGE OF THE JURASSIC CRINOID PENTACRINUS —The imperfection of the geological record is a conception that should constantly be applied to the distribution of extinct creatures no less than to their range in time Many genera of crinoids, long known from only one country or one quarter of the globe, have of late been found to have a far wider, sometimes indeed a world-wide, distribution Uintacrinus, Marsupites, and Saccocoma have yielded instances These, it happens, are all

unstalked forms and if, as some suppose, they were members of the plankton, then their wide distribution is readily explained The latest case, however, is that of a very much-stalked form The species *Pentacrinus subangularis*, recorded from the Middle and Upper Lias of Europe, has now been found in Alaska Dr Frank Springer (Proc U S National Museum, 67, Art 5) also regards as very close relations some columnals previously known from Dakota and Utah and some lately described by himself from Roti in the Dutch East Indies This range, he says, far exceeds that of any crinoid of the present ocean " The deep and clear seas prevailing in the Jurassic and Cretaceous periods were," he thinks, " favourable to the development and spread of marine faunas over large areas with a minimum of checks and interference, in contrast to those of subsequent periods down to the present, in which owing to the great changes in land form affecting the conditions of marine life, and to increasing competition arising from the multiplication of forms, the tendency has been toward progressively greater restriction of faunal areas " This may be, but in this connexion one may recall the many specimens of *Pentacrinus fossilis* attached to logs of wood and may surmise that *P subangularis* also belonged to the pseudo-plankton in its young stages In spite of its wide distribution and its great abundance of individuals the genus Pentacrinus did not, so far as we know survive into Cretaceous times

THE RANGE OF OTHER FOSSIL CRINOIDS —Another instance of a wider distribution than had been supposed is afforded by the genus Apiocrinus This crinoid, of which the Bradford or pear encrinite is the best-known example, is not uncommon in the Jurassic rocks of Europe, but has not hitherto been recorded from America In the Proceedings of the United States National Museum (vol 67, Art 18, 1925) Dr Frank Springer now describes some columnals from rocks, probably of Upper Jurassic age, on the isthmus of Tehuantepec, Mexico, and refers them to this genus as a new species, *A tehuantepec* It is also a genus long known only from Europe at least it was not generally recognised that the Cainozoic form of it was represented in New Zealand Recently, species of this form have been identified from various other regions of the Western Hemisphere, so that it rivals Pentacrinus in its distribution although so much later in time This does not quite substantiate the contrast drawn by Dr Springer It is still unsafe to base conclusions upon our ignorance For example, the fossil comatulids, of which so many species are known from Europe, appear as yet to be represented in America only by the rather obscure Microcrinus of Emmons , no doubt they also will be found

SEISMIC WAVES —The March issue of the *Journal de Physique* contains the results of the observations of the earth and air waves produced by the destruction of melinite on four dates in May 1924 at the camp of La Courtine in the centre of France The earth waves were observed by MM C Maurain, L Eble and H Labrouste by the aid of seismographs recording the vertical, horizontal transverse and horizontal longitudinal movements of the ground at three stations between 5 5 and 25 kilometres from the point of explosion The waves most rapidly propagated affect the vertical and longitudinal instruments only and travel with a mean speed of 5 52 kilometres per second , the slower or long waves affect all three instruments and travel with a mean speed of 2 80 kilometres per second At the station nearest to the explosion a further slight transverse wave of speed 4 kilometres per second was observed At Meudon, 340 kilometres from La Courtine, MM A Perot and F Baldet observed the arrival of the air wave by means of a drum closed by a paper diaphragm and a sensitive flame, and found the mean speed of propagation to be 341 7 metres per second at 16° C , the first effect being a decrease of pressure of 0 6 millimetres of mercury followed by an equal increase

THE NILE AND ITS FLOODS —In " A Short Account of the Nile and its Basin," Dr H E Hurst has published a paper he read to the International Congress of Geography (Cairo, 1925), which contains a useful summary of the latest data, accompanied by a large scale map, with regard to the Nile floods The Nile water supply comes from two sources, first the tributaries rising in Abyssinia, and secondly, the water from the Lake Plateau of East Africa Very little water from the Sudan reaches the Nile, since it is largely evaporated where it falls During September, when the water is highest in the main Nile, the Blue Nile contributes 72 per cent , the Atbara 15 per cent , and the White Nile 13 per cent During the low stage of the main Nile the White Nile supplies 80 per cent of the water The White Nile is at its maximum discharge in October, its waters having been held back from July to September by the rapid rise of the Blue Nile The White Nile water comes from two sources, the Sobat and the Bahr el Gebel and Bahr el Zeraf Very little is known of the details of the regime of the Sobat, but its maximum discharge is in October and November, while the maximum of the Abyssinian tributaries is in September The Bahr el Ghazal, in spite of its large basin with a good rainfall, contributes very little water to the Nile Practically all the discharge of the Gebel and Zeraf comes from the Great Lakes and the plateau, but fully half that enters the swamps of the Gebel is lost The regime of the lakes is not well known

SURFACE DAY VISIBILITY —The Meteorological Office, Air Ministry, in Prof Notes, Vol 3, No 40 (H M Stationery Office, Price 3*d*), has issued a discussion on the ground day visibility at Cranwell, Lincolnshire, during the period April 1, 1920–December 31, 1923, by Mr W H Pick The relationship dealt with is that existing between ground visibility and the surface wind direction, the surface wind velocity, the existing pressure type, and the presence or absence of convection currents For the Cranwell area it is concluded that bad or poor visibility is most frequent with wind calm or from about south-east, while good or very good visibility is most frequent with winds from north-eastward or southward Winds with a greater velocity than 15 m /hr are seldom accompanied by bad or poor day visibility Days with convection, taken as days with cumulus or cumulo-nimbus cloud, are likely to be accompanied by good or very good visibility It is regrettable that, when referring to weather types, numerals only are given, being those affixed by Col Gold in his " Aids to Forecasting," Geophysical Memoirs, Vol 11, No 16 The communication in this respect is comparatively valueless unless the reader has the M O publication referred to In a discussion on similar lines, Prof Notes, Vol 3, No 37, noticed in NATURE December 6 1924, p 838, dealing with pressure type in relation to fog frequency at Scilly during summer months, specimens were given of the different types of weather with which the author was concerned , economy in printing has possibly caused the omission

A WIDE-ANGLE (180°) LENS —A compound lens that enables one to photograph the entire inner surface of a hemisphere at one exposure is described by Mr Conrad Beck in an article in the

Journal of Scientific Instruments, vol 2, No 4, 1925 The principle of the method occurred to Mr W N Bond and to Mr Robin Hill independently, and is that of the view which is obtained of the sky from under water, the "fish's view" Mr Hill has devised the apparatus, which consists of a large front lens of 2¼ inches diameter, with a curved convex outer surface At this surface a view angle of 180° is contracted to a cone of about 90° The inside surface of this lens is very deeply concave, and of such a curve that the central ray from each point of the view passes through it with scarcely any deviation Close to the apex of the light-cone thus formed is a comparatively small photographic lens The combination gives an image of the complete hemisphere on a flat disc about 2½ inches diameter and with an aperture of f/22 good definition is obtained over the whole area The character of the distortion of the image is described, and an undistorted image of any part of the photograph is obtained by reversing the action of the apparatus so that the lens is used to produce the projected image The description is illustrated by 5 photographs of the sky, one of the nave of Ely Cathedral, and enlargements from a part of the last and one of the skies The enlargement of the Cathedral clearly demonstrates the elimination of the distortion

X-RAY ANALYSIS OF SOLID NITROUS OXIDE AND CARBON DIOXIDE —It is noteworthy that the Laboratory of Physics and Physical Chemistry of the Veterinary College at Utrecht, in which van 't Hoff held his first appointment at the time when he enunciated his new theory of "Chemistry in Space," is now producing, under the direction of Prof N H Kolkmeijer, an important series of investigations of space-structure by the modern method of X-ray analysis It was natural that one of the first cases studied in a laboratory so close to that of Prof Cohen should have been that of white and grey tin, with the result that grey tin was shown by Kolkmeijer and Bijl in 1918 to have the familiar lattice-structure of the diamond A more recent paper, reprinted from the Proceedings of the Amsterdam Academy, describes the crystal structure of solid nitrous oxide and carbon dioxide Each substance has a cubic symmetry, the side of the cube containing four molecules of N_2O being 5 72 Å U, whilst that which contains four molecules of CO_2 is 5 63 Å U The distance between two neighbouring atoms is given as 1 15 Å U in N_2O and 1 05 Å U for CO_2 Another paper records the fact that black precipitated mercuric sulphide, although often described as "amorphous," crystallises in the cubic system and has a structure similar to that of the cubic form of zinc sulphide

THE SPECTRA OF ISOTOPES —In the issue of the *Physikalische Zeitschrift* for May 25, Dr G Joos, of Jena, summarises the present state of our knowledge of the influence of isotopes on spectra Up to now trustworthy evidence of such influence has only been furnished in the case of band spectra, in which both the oscillations and rotations of the nucleus are slowed down for the heavier isotopes as, for example, in the well-known case of the hydrogen chloride doublets In other cases the observed change of frequency has been used to determine the constitution of the nucleus the movements of which produce the spectral line, and the hydride of the metal concerned has frequently been found to be the effective material So far, the influence of isotopes on line spectra has only been found in the case of lead, and it appears to be due to some difference of the structure of the nucleus No direct connexion between the satellites of spectral lines and the isotopes of the material appears to exist

THE CONTINUOUS SPECTRA OF THE HALOGENS —After considering the different conditions under which the continuous spectra of iodine vapour and of bromine and chlorine are observed, Dr W Steubing has come to the conclusion that they are not of molecular but of atomic origin, though they are not connected with the normal atomic line spectra of the elements (*Zeitschrift fur Physik*, May 5) For the production of line spectra, accurately defined orbits with definite energy values are necessary, monochromatic emission will not occur when electron jumps take place which cannot be ascribed to a definite quantum orbit, but the emission will be governed by the laws of chance It has been shown by the author that the outer electron layer, in the case of the halogens, is very unstable when acted on by magnetic and electric fields, and it is considered probable that it is also unstable for mechanical shocks, a single electron of a broken-up layer will, at first, have no uniquely defined energy, and will only attain this when the layer is completed Thus the emission will not be monochromatic, but it will lie between certain limits having a definite boundary on the long wave-length side, as is actually observed in these three spectra Other gases and vapours which emit a continuous spectrum do not exhibit a definite boundary towards the red

HYDROGEN-NITROGEN AND LIQUID AMMONIA EQUILIBRIUM —The volume percentages of ammonia in a compressed hydrogen-nitrogen mixture over liquid ammonia have been measured by A T Larson and C A Black, who record their results in the April issue of the Journal of the American Chemical Society A true equilibrium appears to exist The temperature interval used was − 22 5° to 18° and the pressure range 50 to 1000 atm The volume percentages increase with increasing temperature and decreasing pressure, the values are much higher than those calculated from the vapour pressure of liquid ammonia

QUENCHED CARBON STEELS —A valuable little paper on "The Structure of Quenched Carbon Steels" was presented at the recent meeting of the Iron and Steel Institute by B D Enlund, of Sweden He has carried out measurements in order to determine the influence of annealing on the electrical resistivity and the specific volume of quenched carbon steels All the curves show two bends, one appearing at a temperature of 110-120° C and the other at about 250-260° C, according as the carbon content of the steel is high or low These bends are visible in all the curves, thus indicating that the same reactions occur in all the steels The bends consist in all cases of deviations towards the temperature axis which indicates that a precipitation of cementite takes place at the temperatures mentioned As is well known a reaction of this kind is always accompanied by an increase in electrical conductivity From a knowledge of the phenomena occurring in high-carbon steels quenched from a high temperature, it may thus be concluded that the break in the curves at about 110° is caused by the transformation of martensite into troostite, and the second by the resolution of austenite into α iron and cementite Though very slight, the second bend in the curves of the mild steels is quite distinct, and it is thus evident that even such steels contain γ iron representing untransformed austenite This is a very interesting and valuable conclusion to have established The formation of troostite at 110° C is accompanied by a contraction, whereas the precipitation of α iron and cementite at 250° C causes an expansion

The National Physical Laboratory, Teddington

ANNUAL VISITATION

ON Tuesday, June 23, the annual visitation by the General Board of the National Physical Laboratory took place. In accordance with custom a number of members of scientific and technical societies and institutions, government departments and industrial organisations, were also invited to the Laboratory, which was open for inspection. The visitors were received in the new Aerodynamics Building by Sir Charles Sherrington, president of the Royal Society and chairman of the General Board, Sir Arthur Schuster, and the Director of the Laboratory, Sir Joseph Petavel. Prior to the visitation the new entrance to the Laboratory, in Queen's Road, was formally opened by Sir Charles Sherrington.

Referring to the general development of the Laboratory, Sir Charles remarked that it is now twenty-five years since the Laboratory came into being, and in that period it has come to occupy an all-important place in the national organisation for the advancement of science. This rapid growth is a testimony of the energy and ability of the first Director, Sir Richard Glazebrook. With the further expansion under his successor, Sir Joseph Petavel, arose the demand for new roadways. Their construction was begun in 1922, and the projected development included the improvement of the approaches to existing buildings and the reconstruction of the entrance from Queen's Road. It is gratifying that the new roads have been named Kelvin Avenue and Rayleigh Avenue. The service which the late Lord Rayleigh rendered to this institution cannot be overstated, and forms an abiding part of its high tradition.

An extensive series of exhibits had been arranged to illustrate the general character of the work of the Laboratory.

In one of the seven-foot wind channels in the Aerodynamics Department was a model for investigating the performance of the autogyro, a machine representing an innovation in aeroplane design. This machine differs from the orthodox type in that it has no wings, their place being taken by an airscrew on an axis which is nearly vertical. The machine is equipped with a motor and propeller as usual, and the motion of the air past the vertical screw as the machine gathers speed causes it to rotate and to lift the machine from the ground. It is claimed by the inventor of this machine (which is being developed in Spain) that an almost vertical landing is possible and that it will not stall.

In the four-foot wind channel was exhibited an apparatus for investigating rapid fluctuations of wind velocity, such as occur in the eddy region behind an obstacle placed in the channel. Owing to lag, ordinary anemometers cannot follow these variations, and the possibility of using hot wire anemometers for the purpose is being explored. A hot platinum wire forms one arm of a Wheatstone's bridge and changes in wind velocity affect its resistance disturbing the balance of the bridge. The corresponding variations in the current are shown by an Einthoven galvanometer. With the finest platinum wire one-thousandth of an inch in diameter, fluctuations of 2 or 3 per second are faithfully recorded.

In the Engineering Department an interesting exhibit was an instrument for recording the vibrations of structures. In this an arm carrying a small stylus is so pivoted on a frame that it responds to very minute vibrations of the frame. Supported by means of springs is a system possessing large inertia compared with the vibrating portion and carrying a smoked glass plate, on which the vibrations of the stylus are recorded. The stylus magnifies the vibrations twenty times, and a further magnification of fifty times is obtained by optical projection. A testing machine for big-end bearings of petrol engines was also shown. This work has been undertaken in connexion with the development of high-power light-weight internal combustion engines.

Other exhibits included apparatus for investigating the impact strength of chains and for examining the stress set up in pipe sockets due to caulking. In this connexion it has been shown that for some time after caulking there is a definite slow reduction in caulking stress indicated by a gradual reduction of the outside diameter of the socket.

The Department of Metallurgy and Chemistry displayed specimens of light alloys which had been treated for the removal of occluded gases. One of the defects of aluminium alloy cast in sand is "pin-holing" due to the presence of these gases, the degree of occlusion of which is affected by the rate of solidification. If the alloy is cast in a metal mould, solidification is rapid and the gases are retained in solution.

There were also shown examples of the pure metals manganese, chromium, and iron, prepared in the Laboratory. Pure iron and chromium are produced by electrolysis from an aqueous solution of their salts. Pure manganese is prepared by distillation from the commercially pure mineral in a high-frequency induction furnace in vacuum, which is also used in the preparation of pure alloys of these materials. Special refractory crucibles made from pure magnesia and alumina were produced for this purpose. A further exhibit showed beryllium obtained by the electrolysis of fused beryllium salts. The metal has a high degree of purity and is produced by slowly withdrawing the cathode, thus forming a rod which is afterwards melted in the induction furnace already mentioned.

The Chemistry Section displayed apparatus for determining the viscosity of molten glass. The glass is contained in a platinum crucible in an electric furnace, and is withdrawn adhering to a fine platinum wire moving at a definite rate, the temperature of the furnace being observed with an optical pyrometer. The viscosity is obtained from the weight of glass adhering to the wire.

In the William Froude National Tank there was shown the apparatus for the investigation of the movements of a lifeboat on a slip-way during launching. As the boat traverses the slip-way, the progress of its bow and stern are recorded electrically after each fall of 6 inches. The conditions under which the tests are being conducted include varying slip declivity and friction, smooth and stormy water, and different states of the tide. An exhibit of popular interest was a wax model of H.M.S. *Victory*. This was ballasted and towed from the travelling carriage of the tank so as to simulate the course which a sailing ship would take under sail, and its leeway could be measured. The apparatus for determining the resistance and running angle of flying boat hulls in motion prior to taking off was also shown.

In the Metrology Department were a number of exhibits dealing with high precision measurements, and comprising standards and measurements of mass and length, measurements of volume, and the testing of hydrometers, barometers, and chronometers.

Another exhibit was a new form of cadmium lamp

recently invented by M Hamy which contains no internal electrodes It is stated that the spectrum from this is identical with that from the Michelson cadmium lamp, which in the past has been used for experiments on the use of a wave-length of light as a fundamental unit of length The comparison of a 6-in and a 36-in Fabry-Perot etalon illustrated how, by stepping up, lengths of the order of a metre and over can be measured accurately in terms of the ultimate unit

The apparatus for silvering the plates used in interferometry methods of measurement was shown The glass plate forms the anode of a vacuum vessel, and the cathode, of silver, is hung above it The silver film is deposited on to the plate by the passage of an electric discharge Films from 1 to 2 millionths of an inch in thickness can be obtained by this method

In the workshop was a machine for facilitating the accurate lapping of pivots In this the work in progress is magnified by projection, and the operator can compare the magnified image with an outline drawing, on the same scale, of the required profile

The Physics Department was responsible for a large number of exhibits Among them was an apparatus for the determination of the effect of humidity on the mobility of ions A heated platinum wire mounted in an insulated metal tube is used for the production of the ions, which are drawn to the outer tube by the application of an electric field, the thermionic current being measured in the usual manner by means of an electrometer The experiments are conducted at atmospheric pressure, and the humidity of the air surrounding the heated filaments can be adjusted Another interesting exhibit was an apparatus for the determination of the heat loss from bare pipes A graphite rod extending from end to end of a long iron pipe is heated electrically and the energy dissipated in it is measured The corresponding temperatures at various points along the pipe are measured by thermocouples

In the Sound Section was an apparatus for the photographing of sound waves The passage of an electric spark across a short gap produces a single spherical sound pulse, the shadow of which is afterwards photographed under the illumination of a second spark By using this apparatus in conjunction with sectional models of buildings, the acoustic properties of the latter can be determined

The purity of the sounds produced by electrical apparatus used in acoustical work depends upon the wave-form of the electrical oscillations A cathode ray oscillograph for the study of the latter was shown, the spot describing a circle on the fluorescent screen when the oscillations are sinusoidal

Among the exhibits of the Radiology Section were Laue photographs of diamonds used as pivot bearings In this connexion it has been found that the direction of the cleavage plane of the diamond with reference to the bearing surface is of great importance

In the Optics Section were shown a flicker photometer for heterochromatic photometry and a spectrophotometric equipment using unpolarised light In the latter, the absorbing optical parts are reduced to a minimum and measurements are made by a Lummer-Brodhun contrast field As a result the instrument is very efficient at low illuminations It possesses two collimators, and the light from the two sources is brought to approximate equality by means of rotating sector discs, the final balance being obtained by means of a wedge in the path of one of the beams

In the Electrotechnics Department, Alternating Current Division, a recently constructed power-measuring apparatus was on view, including a precision electrostatic wattmeter Another exhibit consisted of the calibration of a 10,000 kilowatt 3-phase wattmeter operating at 6600 volts This calibration is carried out by the employment of a fictitious load method in which the pressure and current coils are separately excited In the Direct Current Division was shown a 5000 volt direct current set, for tests on equipment connected with railway electrification In particular, it has been used for the testing of impregnated timber designed to protect railway workers from shock through accidental contact with the live rail

The exhibits of the Photometry Division included the apparatus for the standardisation of electric incandescent lamps in terms of the international candle and for the measurement of mean spherical candle power In the experimental illumination building, demonstrations of the use of the daylight-factor meter—an instrument for the direct measurement of the proportions of the total external daylight reaching various points in a room—were in progress

In the Wireless Division was an oscillograph used for analysing the wave-form of a valve oscillator and amplifier A condenser in the grid circuit of an oscillator discharges linearly through a diode, and the discharge can be synchronised with the oscillations to be measured The actual wave-form is traced out by the spot on the fluorescent screen of a cathode ray oscillograph Another interesting feature was an apparatus for the measurement of the intensity of the field from a distant radio transmitting station

A number of piezo-electric quartz resonators and oscillators for the purpose of radio frequency standardisation were shown in the Electrical Measurements and Standards Department These oscillators form extremely constant sources of radio frequencies and are capable of controlling the output of valve generators Another exhibit was a standard sonometer for the measurement of audio frequencies The apparatus is very simple in principle It consists of a phosphor-bronze wire loaded with a heavy weight The wire passes between the poles of an electro-magnet and carries the current the frequency of which is under measurement A sliding bridge with rack and pinion enables the free frequency of the wire to be brought into synchronism with that of the source A pointer indicates the frequency directly Various scales corresponding to modes of vibration in one, two, three, five, and ten loops are used The total range is from 100 to 10,000 cycles per second, with an accuracy throughout of 1 in 1000

Glacier Lassitude

ON the Mount Everest Expedition, 1924, a peculiar condition of prostration and lassitude was experienced by its members whilst crossing ice under certain conditions The appearance of this fatigue was found to coincide with the presence of a hot sun and a still air this combination of conditions led to a saturation of the stratum of air on the glacier with moisture, so that the loss of heat from the body was interfered with The effect was not due to altitude alone, since the lassitude disappeared the moment the observers left the glacier, and was not experienced in the early morning or late evening

The explanation of this effect given by Major Hingston has been confirmed by some experiments undertaken by Leonard Hill and A Campbell (*Lancet*, 1925, vol 1 p 939) The authors examined the

effects of work with the bicycle ergometer in ordinary atmospheric air (21 per cent oxygen) with a dry bulb temperature of 20° C and a low cooling power, and with a temperature of about 8° C and a high cooling power, and compared them with those produced by similar temperatures when the air breathed contained only 11-13 per cent of oxygen this level of oxygen was sufficiently low to produce symptoms of deficiency of oxygen in the experimental subject, such as weakness, giddiness, and cyanosis It was found that an atmosphere with a low cooling power, or one with a lowered oxygen content, increased the pulse-rate more than one with a higher cooling power or a normal oxygen content the effect of cooling power was observed whether the atmosphere contained a low or a normal amount of oxygen while the effect of variation in the oxygen supply was seen independently of the cooling power of the atmosphere When the two more disadvantageous conditions were combined in one experiment, that is, a lowered percentage of oxygen in the air breathed together with a low cooling power of this atmosphere, the increase in the pulse-rate was about equal to the increase due to the anoxæmia plus that due to the low cooling power In the two subjects examined, the increase due to these two factors combined was about 24 and 36 beats per minute respectively and at the same time the symptoms of anoxæmia and discomfort were more marked under warm conditions with a low oxygen tension It was also found that there was no hindrance to the passage of oxygen across the pulmonary epithelium when air with a low oxygen tension but saturated with moisture was breathed, so that the results observed appear to be due to the two factors of overheating of the body and of breathing oxygen at low tension The pulse-rate alone is a guide to the distress of the heart under these conditions

An obvious means of counteracting the effects of altitude is to increase the oxygen in the air breathed by a supply from some form of apparatus, but in the last expedition this method was found to be of little benefit Hill and Campbell make the following suggestions to account for this finding The observers have been in an atmosphere containing a low oxygen tension for a considerable time and the effects of enriching this atmosphere with oxygen may be different from those observed in unacclimatised subjects submitted to acute anoxæmia for short periods A further factor is the difficulty of obtaining the full amount of oxygen given by the apparatus, some being almost inevitably wasted, without the wearing of a face-piece Finally the authors lay stress on the oxygen dissolved in the plasma in distinction from that in combination with the hæmoglobin in the corpuscles It is of course the dissolved gas which is immediately available for the tissues, and the amount of this depends on the tension of the gas in the alveoli of the lung Breathing air containing 30 per cent oxygen at 29,000 feet would give only about 60 mm mercury tension of this gas in the alveolar air Although this would saturate the hæmoglobin to 90 per cent, the amount of gas dissolved in the plasma would be only about two-thirds of that normally present when ordinary atmospheric air is breathed, so that the supply available for the tissues would still be distinctly subnormal

The Middle Carboniferous of the North of England

Mr W S Bisat's paper on "The Carboniferous Goniatites of the North of England and their Zones" (Proc Yorks Geol Soc, N S vol 20, 1924, pp 40-124 and Pl I-X) must take rank as one of the classics of Carboniferous stratigraphy It provides the first clear guide to the 'no man's land' of grits and shales which lie between the Carboniferous Limestone and the coal measures, while it will also be of the greatest value in the correlation of the Coal Measures themselves by providing a sure base from which to work

The Goniatite succession is traced from the upper Viséan to the base of the Upper Coal Measures (of Lancs and Yorks) Zones D3 and P (the latter characterised by *Goniatites s s*) are retained in the Viséan They are represented by the "knoll" limestones and the Bowland shales which are regarded as in part contemporaneous For the overlying beds, up to and including part of the Lower Coal Measures, the term Lancastrian is introduced These beds are divided into the zones of Eumorphoceras (E), Homoceras (H), Reticuloceras (R) and Gastrioceras (G) in ascending order Hinde's Pendleside group (=Bowland shales) is found to be substantially equivalent to the Yoredales in age, and it is therefore proposed to discard the term, retaining Bowland shales as a facies name The group belongs partly to P (Viséan) and partly to E (Lancastrian) The Yoredales of Derbyshire belong mainly to a higher horizon (upper E and H), corresponding to the Sabden shales of the Pendle area, while the overlying Kinderscout grit and shale is referred to R, leaving the upper portion of zone R together with zone G for the higher grits and part of the Lower Coal Measures The major (generic) zones named above are divided into minor (species) zones, of which twenty-one are recognised Local details of the zonal determinations are given somewhat fully for south Yorkshire and Lancashire, with more brief reference to other areas

The value of the stratigraphical portion of the paper is dependent on the full study of Goniatite palæontology on which it is based, and which forms the second (and larger) section This constitutes a monograph on the family and one only regrets that it is not in more definitely monographic form In its present relations, it is naturally concerned mainly with the diagnostic characters of species and varieties, and has less emphasis on their mutual relations and general evolution, though the section commences with an excellent key to the genera The ontogenetic history is found to be strikingly uniform throughout the family, especially in regard to sutures but with the usual independence in the rate of development of the several characters Fifteen genera (four new) and fifty-six species (thirteen new) are described The largest number belong to the zones D, P, E, and H, below the Kinderscout grit Above that horizon only Reticuloceras (in the grits) and Gastrioceras (in the upper grits and Lower Coal Measures) appear to occur A noteworthy feature is that the sutural development is at its maximum in the earliest zones, the species which follow being evidently katagenetic in this respect The history of the other characters is less obvious, but the striking reduction in the number of species and the variability of the later forms seem to confirm a general decadence of the family All those interested in Carboniferous stratigraphy will look forward with the highest interest to the further extension of Mr Bisat's work

The same part of the Yorkshire Geological Society's Proceedings contains a valuable resume by Mr G W Lamplugh of our present knowledge of the Speeton clays (the presidential address) as well as other important contributions

Societies and Academies

LONDON

Optical Society, May 14 —F W **Preston** (1) The fundamental law of annealing The fundamental law of annealing, that the rate of decrease of stress varies as the square of the stress present, is deduced from first principles by means of dimensional analysis, assuming that the rate of decrease of stress depends, (1) only on the stress present and the viscosity, (2) on the stress present, the viscosity, and the rigidity of the material The law suggested as an empirical relation by Adams and Williamson is true dimensionally —(2) The dimensional accuracy of Mr Hampton's paper on " The Annealing of Glass " No corrections are made in Mr Hampton's results, which are based on sound reasoning The practical conclusions of Mr Hampton's paper are justified in every way —T **Smith** Note on the cosine law Objections raised to the statement that rays selected by a cosine relation determine caustic surfaces in the object and image spaces, and to some points in the proof of the cosine law, are considered, and the adoption of the original enunciation of the theorem justified as opposed to the modified form suggested by Hertzberger and approved by Boegehold A direct derivation of the analytical form of the law of refraction from the cosine law is given

Royal Statistical Society, May 19 —Sir Napier **Shaw** Week or month as an intermediate time-unit for statistics In agriculture the week is generally recognised, but the month often exerts a certain dominance in finance the year is the chief unit and next to that the week, for meteorology the calendar month is dominant and the week is only used at present for special purposes such as correlation with agriculture or hygiene, for railway statistics the calendar month and year again are dominant, for social statistics (Poor Law, etc), the week is the favourite unit, for trade and shipping the month is used exclusively, whereas the week and corresponding quarters are the bases of vital statistics in the majority of countries, Brazil, Bulgaria, Hungary and Italy, however, use the month for that purpose Starting from the conclusions (1) that the original purpose of the month to keep in touch with the phases of the moon has not been successful, (2) that the division of the year into twelve unequal parts is not a fundamental principle of statistical science, (3) that a period shorter than a month is necessary for various reasons of correlation, and (4) that there is no possibility of using monthly data in connexion with weekly data or vice versa, a suggestion is put forward for placing statistical data upon a basis of weeks or groups of weeks with an adjustment to the calendar year The grouping of the fifty-two weeks of the year into thirteen groups of four weeks each, or four groups of thirteen weeks each, is left open For general climatic purposes a quarterly arrangement with judicious selection of the quarters might be sufficient

Geological Society, May 20 —H **Dewey** Palæolithic implements of Chellean type found in the gravel of Hyde Park, London The implements were collected from gravel thrown out of a deep trench of length 44 feet, breadth 14 feet, depth 40 feet The London clay has been exposed at the northern end of the excavation, but falls suddenly at the southern end to an unknown depth The gravel therefore covers a step-like fracture, which curves round from west and east to north-east The stones are principally Chalk-flints The implements were all from a depth of 26 feet They include one hand-axe of Chellean type, the topmost portion of a second hand-axe, two choppers worked along the edges so as to provide a comfortable hold two long flakes or flake-scrapers, a broad flake or grattoir, and some pieces showing a certain amount of human workmanship —J W **Tutcher** and A E **Trueman** The Liassic rocks of the Radstock District (Somerset) These rocks are unusually interesting, because in some divisions they are very thin, the total thickness of Lias does not exceed 200 feet and is often much less The succession of rocks has been worked out An unusual number of ammonite faunas are richly represented, often in remanie deposits Deposition of White Lias occurred during a time of fairly uniform subsidence, and was followed by folding along east-and-west axes, and denudations of the anticlinal areas Deposition was renewed and followed by uplift in the south and denudation of much of the clay there Then came deposition of the Obtusum nodule-bed and of the Raricostatum clay, and afterwards renewed uplift in the south and denudation Further deposition included the Armatum bed in the south only, a remanie bed, the Jamesoni limestone, fairly uniformly, and the Striatum and Capricornum clays

EDINBURGH

Royal Society, May 25 —John **Thomson** Parasitism of *Cuscuta reflexa* (Roxb) The hyphæ or modified root-hairs are differentiated into strands of tracheids when they meet the xylem vessels of the host Those which enter the host phloem are not modified, moreover, the shaft of the haustorium contains no sieve-tubes The irritation set up by the entry of the haustorium stimulates all the living cells in the neighbourhood of the haustorium to active cell-division In woody host stems the general result is to increase the radius of the stem of the host on the side invaded by the parasite Connexion with the host xylem is maintained by the differentiation into tracheids of young parenchyma cells at the tip of the haustorium Experiments in growing the parasite on peeled stems demonstrate that the plant can live on the materials derived from its host's wood, even when its chlorophyll is prevented from functioning by enclosure in a light-tight box The haustoria formed in such circumstances are perfectly normal except that their size is less These facts suggest that a plant's xylem is capable of transporting plastic materials as well as water with mineral salts in solution —C W **Wardlaw** Size in relation to internal morphology No 2, The vascular system of Selaginella The xylem is in the form of a thin ribbon, an arrangement which makes for a large surface of interchange with living tissue With increase in size the xylem band widens out Where the vascular system is of large size, the broad stelar ribbon must be broken up in order to be adequately disposed in the stem Such species are polystelic, with three to five stelar ribbons, and measurements show that a constant ratio exists between the width of the median stele and the diameter of the stem The polystelic species have been regarded as derivative and specialised types From the foregoing argument, however, it follows that polystely is not necessarily a derivative condition in the phyletic sense, but is a modification in form consequent on increase in size Hence the isolated position of those species which show polystely in Baker's systematic arrangement need not be held as destructive of the validity of that classification —S **Williams** Some points in the anatomy of Dicksonia *D antartica* and *squarrosa*

possess dictyosteles not far removed from solenostely In both the stele appears in transverse section as a curiously corrugated cylinder due to the oblique passage of the leaf traces through the cortex Inwardly projecting flanges are present in both species at the margins of the leaf gaps From a study of the anatomy of the above large stems and of a number of other examples, it is concluded that increase in size of the stele in the vast majority of ferns has been accompanied by (*a*) adaptations to increase the surface of interchange between the stele and the surrounding tissues, and (*b*) modifications of the xylem mass to ensure constant contact between the tracheids and living parenchymatous elements —A E **Trueman** and Miss Daisy **Williams** Studies in ammonites of the family Echioceratidæ The paper deals with those ammonites from the Lower Lias which were formerly referred to *Echioceras raricostatum* In creating several genera and in describing the species, considerable attention has been paid to the evidence obtained from the study of the ammonite sutures and from the shell development Discussing relationships and descent, it is shown that the development of an ammonite shell frequently tends to follow the most direct line from the embryo to the adult form, and that this ideal ontogeny may be achieved by the skipping of ancestral stages which do not fall on the direct line or which do not fit the embryo for its particular environment

PARIS

Academy of Sciences, June 8 —L **Lecornu** The phenomenon of refraction A discussion of the condition which must be fulfilled by a force acting on a material point so that its velocity on change of medium may vary as predicted by the wave theory Jules **Andrade** Concerning a theorem of metrology elastic clocks and spiral balances — — **Tzitzeica** Certain skew curves —M **Soubbotine** The law of errors of observation —Lawrence M **Graves** Taylor's theorem in general analysis —D **Pompeiu** The monogeneity of functions of one complex variable — P **Nogues** The invention of the kinematograph During the period from 1882 to 1890, Marey realised the fundamental arrangement which constitutes what is now called the kinematograph —L **Ollat** The resonance of coupled circuits —J **Cayrel** Detection with galena With a single isolated sensitive crystal, only the (111) faces have given rise to normal intense detection The (100) faces, on the contrary, show a very feeble detection, nearly always inverted and often unstable With insensitive crystals the (111) and (100) faces behave similarly both show inversion —E **Bodin** The peculiarities presented by radiation cells of great electrical resistance —G **Ribaud** High frequency induction electric furnaces for the production of very high temperatures A description of the construction of an induction furnace open at two ends and permitting the attainment of a temperature of 2500° C —G **Reboul** A new mode of production of slow cathode rays —La **Rosa** The velocity of light and its dependence on the movement of the source of light Reply to a communication by M Salet — Leon and Eugene **Bloch** The spark spectra of chlorine An extension of the method of analysis of spark spectra given by the authors in an earlier communication and its application to the analysis of the spark spectra of chlorine —Pierre **Auger** and Francis **Perrin** Theoretical considerations on the directions of emission of the photo-electrons — Pierre **Brun** The miscibility of mixtures of water, ethyl alcohol, and isobutyl alcohol The results of the experiments are given in the form of graphs — Georges **Deniges** A new method of diagnosis and of immediate determination of cobalt by spectroscopy and chromoscopy The blue colour given by cobalt compounds with hydrochloric acid has a specific absorption spectrum the reaction detects 0 02 milligram per cubic centimetre of solution The method is of service in the detection and estimation of traces of cobalt in commercial nickel and its salts —Maurice **Nicloux** The determination of carbon monoxide by the blood method and some remarks on the absorption of this gas by hæmoglobin in the absence of oxygen Details of the technique of the method, which is shown to be capable of detecting carbon monoxide in the proportion of 3 parts per million —M **Bourguel** The hydrogenation of the triple link The formation of *cis*-ethylenic compounds Using colloidal palladium as the catalytic agent, the reduction with hydrogen at the ordinary temperature of various acetylene derivatives has always given the *cis*-ethylene compound This is in accord with the geometrical representation ordinarily adopted for the double and triple linkages in acetylene and ethylene derivatives —Max and Michel **Polonovski** The aminoxides of the alkaloids of the tropane group —R **Locquin** and R **Heilmann** New trinitrogen bases the ureas of the pyrazolines —E E **Blaise** and Mlle M **Montagne** The acyclic δ-diketones Transformation into pyridine derivatives The action of hydroxylamine upon the δ-diketones constitutes a general method for the preparation of pyridine bases —R **Bourret** The geology of the region of Pak Lay (Middle Laos) —L **Duparc** Some curious lode-bearing rocks in the neighbourhood of Mestigmer (Morocco) —E Vander **Linden** A case of striking by lightning —Marcel **Mirande** The phytosterol of the scales of bulbs in the species of the genus Lilium —C **Charaux** and P **Delauney** The presence of loroglossine in *Listera ovata* and *Epipactis palustris* and on some new reactions of this glucoside —R de **Litardiere** The phenomenon of cytomixis in the microsporocytes of *Podophyllum peltatum* —Ladislas **Smolik** The exchange of the aluminium ion of soils of different types against the potassium ion of a neutral salt —Antonin **Nemec** The hydrogen-ion concentration in the tissue of seeds The experiments recorded show that the hydrogen ion concentration in the seed tissues indicates, at least approximately, the value for the reaction of the medium favourable to the development of the plants arising from the seeds —Auguste **Lumiere** and Remi **Courjon** The influence of the time of coagulation of the blood on the toxicity of sera —L M **Betances** The genesis of the blood platelets —H **Chatellier** and H P **Chatellier** The embryological evolution of the endolymphatic outlet in man —E **Aubel** and J **Salabartan** The significance of the decomposition products formed by the coli bacillus at the expense of glucose —P **Lasareff** The statistical theory of the adaptation of the eye in the course of peripheral vision —Ch **Porcher** The action of carbonic acid on the calcium caseinates Introduction to the study of colloidal calcium carbonate —P Cappe de **Baillon** The general characters of double monsters in phasmids —J **Beauverie** Does the bacterial symplasm exist? The case of Azobacter After an extended period of cultivation of *Azobacter chroococcum*, it has not been found possible to prove the existence of a regenerative symplasm which was not the result of a degenerescence, of a contamination, or of an erroneous interpretation The author regards the formation of a bacterial symplasm as unproven —Charles **Kayser** and Mlle Eliane Le **Breton** The regulating mechanism of purin metabolism diabetes — — **Paillot** The cytological

alterations in the course of the evolution of the disease of the nucleus of the larvæ of *Pieris Brassicæ*

Cape Town

Royal Society of South Africa, April 15—H **Spencer Jones** Notes on solar parallax A good determination of this constant is important for establishing a base-line on which our knowledge of the dimensions of the visible universe is founded The methods of its determination may be divided into three classes (1) The observation of the apparent displacements of a planet like Mars or Eros against one or more stars viewed from two points differently situated in relation to the centre of the earth, (2) determinations of the orbital velocity of the earth compared with the velocity of light, (3) observations of occultations of stars by the moon, from which the perturbing influence of the sun on the moon's orbit can be ascertained The best determinations of the solar parallax from these three independent methods lead to almost identical results, namely, 8″ 805 with a probable error $\pm 0''$ 002—Louis P **Bosman** Some observations on aconitine Aconitine ($C_{34}H_{47}NO_{11}$) on oxidation yields oxonitine $C_{24}H_{31}NO_9$ It is known to contain three (CH_3O) groups, one (CH_3CO) group, one (C_6H_5CO) group, and one N CH_3 group There seems to be an inner anhydride of a dicarboxylic acid

Washington, D C

National Academy of Sciences (Proc Vol 11, No 4, April)—T Y **Thomas** On the projective and equi-projective geometries of paths—O **Veblen** and J M **Thomas** Projective normal co-ordinates for the geometry of paths They are independent of the components of affine connexion appearing in the differential equations of the paths Equations of paths through the origin are linear—J M **Thomas** Note on the projective geometry of paths Projective tensors other than the Weyl curvature tensor can be derived—W **Hovgaard** Determination of the stresses in a beam by means of the principle of least work No *a priori* assumptions are made as in Saint-Venant's method—M T **Bogert** and C N **Andersen** Researches on selenium organic compounds V A simple method for the synthesis of 2-substituted benzoselenazoles—Alice H **Armstrong**, W. **Duane**, and R J **Havighurst** The reflection of X-rays by alkali halide crystals Using a potassium iodide crystal and reflecting X-rays from the 100 planes gave a double image and a series of fine lines, due apparently to minute crystals with their axes parallel to that of the main crystal This habit of crystal growth is suggested as the cause of the abnormal reflections obtained with the alkali halides—I I **Rabinov** Note on the diffraction of X-rays by a wedge-shaped slit A fringe was obtained using the K_α line of molybdenum Calculated width of slit, 0 0013-0 0018 mm—D L **Webster** and P A **Ross** The Compton effect with hard X-rays—E O **Salant** The heat capacity of solid aliphatic crystals Many assumptions are made, but equations are derived from which results fairly in accord with experiment can be computed—G P **Baxter** and H W **Starkweather** The density and atomic weight of helium Three 1-litre globes were used, as in the determination of the density of oxygen (Nature, March 28, p 483) Average density of helium, 0 17845 Using the density found above for oxygen, namely, 1 42901, and assuming that helium obeys Boyle's Law for the range 0-1 atmosphere, the atomic weight of helium, for various values of $(PV)_0/(PV)_1$ of oxygen, varies from 3 9995 to 4 0000

Diary of Societies

TUESDAY, July 14

Society of Chemical Industry (Annual Meeting) (at Leeds) at 11 a m—Presentation of the society's medal to W F Reid—Presidential Address Dyestuffs—In evening—Prince G Conti How the Tuscany Boric Acid is made (Lecture)

Convention of English Speaking Ophthalmological Societies (at University College) (also on July 15 16, 17)

WEDNESDAY July 15

Society of Chemical Industry (Annual Meeting) (at Leeds), at 9 30 a m—Symposium on Coking Practice Chairman Prof J W Cobb—Dr R Lessing The Influence of Ash Constituents on the Coking Process—R A Mott and R Wigginton The Heating of Coke Ovens—C P Finn The Disposal of Coke Oven Gas for Public Supply—W H Hoffert A Comparison of Different Solid Adsorbents proposed for Benzole Recovery

International Conference of Women in Science Industry, and Commerce (at British Empire Exhibition Wembley), at 11 a m—Opening of the Conference by the President, H R H the Duchess of York—Speakers Viscountess Rhondda Commerce—Miss Ellen Wilkinson Industrial Organisation—Prof Winifred Cullis Science

Eugenics Education Society (at Royal Society), at 8 30—Dr J A Mjoen The Analysis of the Component Faculties of Musical Ability and their Inheritance (Lecture)

THURSDAY, July 16

Society of Chemical Industry (Annual Meeting) (at Leeds), at 9 30 a m—Symposium on Smokeless Fuel—Dr C H Lander and Dr Margaret Fishenden Smokeless Fuel—the Present Position and Future Possibilities—E C Evans Solid Smokeless Fuels their Production, Properties, and Use—F S Sinnatt and J G King A Study of the Tars and Oils obtained from Coal

International Conference of Women in Science Industry, and Commerce (at British Empire Exhibition, Wembley) at 10 30 a m—Engineering Chemistry, and Research—Miss H M Davis Electricity applied to Mining—Miss Isabel H Hadfield Some Chemical Problems in the Cotton Industry—Miss Ethel Bailey Automotive Research—At 2 30—Industrial Welfare and Factory Inspection—Miss Constance Smith The Woman Factory Inspector in Industrial History—Miss C U Kerr The Effect of Welfare Work on Health and Efficiency—Miss E E Wilson The Possibilities of Advancement for Women in Industry

FRIDAY, July 17

Institution of Chemical Engineers (Annual Meeting) (in Philosophical Hall, Leeds) at 9 a m—At 9 30 a m (Joint Meeting with the American Institute of Chemical Engineers)—Presidential Addresses by the President of the American Institute, Dr C L Reese and the President of the British Institution Sir Arthur Duckham—At 10 30 a m—Symposium on Industrial Water Supply and Stream Pollution—I P Veitch and L C Benedict Wool Scouring Waste Liquors Composition and Disposal—Dr T L Bailey Effluents from Ammonia Plants and their Disposal—R D Littlefield Distillery Waste Liquids and their Purification—E B Besselievre Statutory Regulation of Stream Pollution and the Common Law—Dr F B Higgins and J P O'Callaghan The Preparation and Comparative Performance of Base Exchange Materials in Water Softening—Dr T P Hilditch Recent Experience of Doucil in Water Softening—H C Parker Electrolytic Conductivity and Hydrogen Ion Control—S L Tyler The Absorption of Hydrochloric Acid and Some Data regarding the Tyler Vitreosil System—W L Stevenson The State versus Industry, or The State with Industry—J W Sale Pioneer Studies by the Bureau of Chemistry on Pollution of Shellfish Areas

International Conference of Women in Science, Industry, and Commerce (at British Empire Exhibition, Wembley), at 10 0 a m—Commerce and Salesmanship—Miss G Bulton Salesmanship—Miss L F Nettlefold The Place of the Wholesaler in the Scheme of Distribution—At 2 30—Electricity—Domestic Science—Miss M Partridge Producing and Distributing Electricity—Miss T J Dillon At Home with Electricity

SATURDAY, July 18

Institution of Municipal and County Engineers (at Town Hall, Folkestone), at 11 a m—A E Nichols Municipal Works at Folkestone—E C Fawcett Folkestone's New Sea Outfall Works

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Evolution and Intellectual Freedom

THE agitation in the United States over the teaching of evolution is attracting such widespread interest that it has been proposed to build a stadium to accommodate twenty thousand people for the trial of J T Scopes, a Tennessee High School science teacher, for having taught the truth of evolution in defiance of the State law The trial is to open on July 10 The charge of the judge to the grand jury began by reading the first chapter of Genesis as the account of creation which Tennessee teachers must adopt He pointed out that part of the value of education is mental discipline, and that flagrant defiance of the law by the school authorities would not be a wholesome influence in the State He insisted that the integrity of the law must be upheld The main issue, however, will be decided by the Federal Court in its decision as to the right of a State to prohibit the teaching of fundamental philosophical principles

The defence of evolution has been undertaken by the American Association for the Advancement of Science, which has appointed a committee of three distinguished biologists, Prof E G Conklin, professor of biology at Princeton, Dr C B Davenport, director of the Station for Experimental Evolution, Carnegie Institution of Washington, and Dr H F Osborn, president of the trustees of the American Museum of Natural History, New York, to prepare a resolution upon the subject The resolution, which has been adopted by the Council of the Association, is as follows

' (1) The council of the association affirms that, so far as the scientific evidences of the evolution of plants and animals and man are concerned, there is no ground whatever for the assertion that these evidences constitute a ' mere guess ' No scientific generalization is more strongly supported by thoroughly tested evidence than is that of organic evolution

(2) The council of the association affirms that the evidences in favor of the evolution of man are sufficient to convince every scientist of note in the world, and that these evidences are increasing in number and importance every year

(3) The council of the association also affirms that the theory of evolution is one of the most potent of the great influences for good that have thus far entered into human experience, it has promoted the progress of knowledge, it has fostered unprejudiced inquiry, and it has served as an invaluable aid in humanity's search for truth in many fields

(4) The council of the association is convinced that any legislation attempting to limit the teaching of any scientific doctrine so well established and so widely accepted by specialists as is the doctrine of evolution would be a profound mistake, which could not fail to injure and retard the advancement of knowledge and of human welfare by denying the freedom of teaching and inquiry which is essential to all progress "

The American Medical Association has expressed itself similarly in a resolution, passed by its House of Delegates, on the question of the teaching of evolution, " that any restrictions of the proper study of scientific fact in regularly established scientific institutions be considered inimical to the progress of science and to the public welfare "

The American Association is being helped in preparing a defence by the Science League, which was founded last year in San Francisco in order to secure liberty of teaching in American education

These organisations have to meet a widespread and well-organised attack The teaching of evolution has already been prohibited by law in Oklahoma and Tennessee Bills for the same purpose were submitted to the State legislatures in Kentucky and in Texas and were rejected by the Upper House, in Kentucky by a majority of one vote In Florida the legislature passed a resolution advising the educational authorities not to employ those who teach Darwinism, and the agitation for direct prohibition is still maintained In North and South Carolina legislative action against the teaching of evolution was defeated, but text-books and teachers who favour evolution are debarred from the State schools Georgia has as yet no absolute legislation on the subject, but the State Education Committee last July advised the legislature to refuse grants to any school, college, or university that favoured the doctrine of evolution, and it has recently withheld a grant from a State library because it contains books on evolution Bills against the teaching of evolution are being introduced or have been introduced into the legislatures of the States of Arizona, Arkansas, Georgia, Illinois, Indiana, Iowa, Minnesota, Mississippi, North Dakota, Oregon, and West Virginia

In California the effort was made, as mentioned in NATURE of May 9, p 683, to avert a struggle by reference of the question to a committee of the nine

presidents of the State universities and leading colleges Six of these colleges are under denominational control, and the unsatisfactory compromise previously referred to in NATURE has not satisfied either side A requisition is being signed for a reference of the question to a ballot at the next election, and the Fundamentalists are said to be confident that they will carry the State, unless books which give even a moderate approval of evolution are excluded from the schools

The anti-evolution party is being supported to some extent by the publishers Thus, one distinguished New York biologist has been requested by his publisher to omit any reference to evolution in any new editions of his text-book, owing to the objections of the Southern and Western States The intellectual terrorism in some of the States may be judged by the fact that according to the *Boston Evening Transcript* of May 23, although, while the anti-evolution Bill was before the legislature in Tennessee, many clergy protested against the proposed infringement of freedom of opinion, "there was never a word of protest from the State University" The North-eastern States show by the comments of the Press their deep regret at this outbreak of intellectual obscurantism, and it is to be hoped that an authoritative expression of opinion there may help the Southern and Western States to realise the heavy handicap they would be laying upon themselves, as well as upon their universities and schools, by the legal prohibition of well-established scientific principles

In Great Britain, State interference with university teaching would not be tolerated The proper body to decide what may or may not be taught in a university is the Senate or Council, and not a popularly elected civic chamber of any kind It must not be forgotten, however, that education authorities in England exercise the right of control over the teaching of religious doctrine in schools, and that they could apply the same powers to the teaching of evolution if they wished It is not for us, therefore, to attempt to justify what seems to have been a breach of law in the State of Tennessee, however much we may deplore that a State should pass a measure which is contrary to all modern ideas of progressive thought and intellectual freedom What we are concerned with is the principle by which a political party or organisation should be able to put obstacles in the way of human enlightenment and independent thought, and should have the power of approving, or preventing, the teaching of scientific facts or conclusions of any kind We have long passed the stage at which this was possible in England, and cannot help being astonished, therefore, that there should be States in the United States of America which deliberately adopt a policy of scientific stagnation

In order to ascertain the views of leading authorities in the fields of university work, science and religious teaching, upon this attitude, advance proofs of this article have been sent to a number of representative men, whose comments, here subjoined, will, we believe, be read with interest on both sides of the Atlantic

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Prof WM ADAMS BROWN, Ph D, D D,
Roosevelt Professor of Systematic Theology, Union Theological Seminary, New York

MY friend, Prof Wildon Carr, has suggested to me that it might interest readers of NATURE to learn the views of an American observer as to some of the antecedents of the singular case presently to be tried in Tennessee The incident, dramatic as it is, is not an isolated event, but part of a movement the beginnings of which go back many years, and has already caused a serious rift in several of the more important denominations, it cannot be understood without reference to its larger setting

The first factor to be borne in mind is geographical The United States, in spite of its hundred and ten millions of people, is still, judged by European standards, sparsely settled, and within its ample borders includes populations separated from one another by differences of antecedents, habits, and tastes, scarcely less marked than those which separate the different countries of Europe There are wide areas of the United States in which the inhabitants know as little of what goes on along the Atlantic seaboard as the inhabitants of China or India To understand the psychology of Fundamentalism, one must see such a play as "Sun-up," and remember that it truthfully describes the mental attitude of hundreds of thousands of American citizens of the purest English stock

A second factor to be reckoned with is the tendency of Americans to standardise their thinking This characteristic, which constantly surprises the English visitor, accustomed to the free expression of individual opinion on every topic under the sun, has its explanation, if not its justification, in the exceptional conditions under which the American democracy has developed its national life With a people recruited from every quarter of the globe, living under conditions which stimulate individual initiative, there was grave danger that the unity of the national life might be lost unless the variant elements could be held in check by a powerful public opinion In Great Britain, centuries of tradition have fixed habits of action in certain definite grooves, and one can safely allow himself the luxury of freedom in his thinking

In the United States, where tradition is at a discount, and each man does what the need of the moment seems to require, there must be some steadying and conservative influence, and this, apart from the written constitution, is supplied by a powerful and often tyrannous public opinion What is going on in religion in the so-called Fundamentalist movement has its parallels in economics and in politics Feeling is often substituted for reason, and the nonconformist is punished by social disapproval, if not ostracism

To understand the theological antecedents of Fundamentalism one must go back a generation to the Briggs case, the celebrated heresy trial of the last decade of the last century, which in so many ways paralleled the Robertson Smith case in Scotland There, as here, the issue was the inerrancy of the Scripture, there, as here, the first result was the condemnation of the accused, but, at this point, the parallel ceases In Scotland, the result was a revival of Biblical study carried into the homes of the people by a generation of ministers who were teachers as well as preachers—a revival which familiarised the rank and file of the people with the issues involved, robbed criticism of its terrors, and prepared the way for the saner and more scientific theology of to-day In the United States, this result followed with certain individuals and in certain sections of the country, but for the most part the effect was different The Briggs case shook the faith of many a minister in the old theology without giving him a firm grasp on the new He therefore ceased preaching theology altogether and turned to social service or some other practical interest as a substitute The result is that the present issue comes upon a people unprepared to meet it, and easily swept away by the plausible rhetoric of an orator like Mr Bryan, who has learned by long practice to make words do duty for ideas

It must be further recognised that when their real interest is separated from the fantastic opinions with which they have associated it, the Fundamentalists are contending for something with which men of a very different mental outlook may feel sympathy, namely, a positive and constructive Gospel In the general loosening of old ties which has been the aftermath of the War not a few self-styled liberals have been ready to break completely with the past, and lightly to surrender values painfully won by the labour and sacrifices of many generations The spectacle of this light-hearted radicalism has seriously alarmed many who would have been ready to respond to a saner presentation of the newer views, and, yielding all too readily to the psychology of the crowd, they have allowed themselves to lend their support to positions which, under less trying conditions, they would be the first to repudiate It is not the first time in the history of religion that a good cause has been discredited by the agents of which it has made use

One further point requires brief notice In spite of the factors I have mentioned, the controversy would not have reached its present acute stage if there had not been on the Fundamentalist side a systematic popular campaign, amply financed, which has carried the cry of the Gospel in danger into every section of the country Only recently have the advocates of a reasonable Christianity realised the danger which confronted them, and organised for a similar campaign of education on the other side That realisation has, however, come at last and that organisation been effected, and unless the American people have been permanently bereft of the good sense which has hitherto characterised them in critical hours, we may confidently expect that the forces of reaction will be checked, and a reasonable liberty of thought be safeguarded

Sir Ray Lankester, K C B, F R S
Formerly Director of the Natural History Departments of the British Museum

In the article about to be published in Nature which you have sent to me for comment, I do not find any definite information as to the law or laws said to be operative in certain States of the American Union by which the teaching of the doctrine of evolution is forbidden, nor do I find any precise statement of the power said to be exercised by certain States of withholding pecuniary support or, on the other hand, of giving it to colleges or schools which teach or do not teach subjects approved or disapproved by the State legislature One must suppose that such *direct* control of the educational programme of colleges and schools supported by grants from the public purse is approved by the citizens who elect the legislative body If the wishes of the constituency are carried out, lookers on may regret or disagree with the programme enacted, but must admit that the action is in accordance with the fundamental principles of self-government If the action is not in accordance with the wishes of a majority of the constituency, that majority can elect new representatives pledged to the policy it prefers

Another very important question is raised in your article about which I have no information You say that the Federal Court has the power "to decide as to the right of a State to prohibit the teaching of fundamental philosophical principles" One would wish to hear more about this power of the Federal Court, and also as to the interpretation of the term "fundamental philosophical principles" In the absence of information on these matters it would be rash to pursue the

subject further. Clearly enough (in my opinion) the integrity of the law must be upheld. The "law" can be altered by a regular constitutional method, but there seems to be no justification for disobeying it instead of repealing it.

The normal and healthy result of the exclusion from State colleges of "studies" which many citizens desire to be made accessible for themselves and their young people, must be to bring about a "boycot" of the State institutions in question, and the endowment of free "nonconformist" colleges to take their place. In many respects educational enterprise flourishes best when free from State interference, State prejudice, State ignorance, and State jobbery. The great universities of the United States are independent corporations, and so are Oxford and Cambridge and their colleges, and so too are the other great universities of Britain. The State government does not at the present day presume to control their programme of studies, but rather protects them from fanatical influences and secures them in the possession of property which enables them to pursue the making and the diffusion of knowledge with independence and self-respect. The present freedom of student and professor and the self-governing status of "Universities" in Great Britain is the outcome of long and historical struggle. That status is not theoretically complete even now, but is in a reasonable state of adjustment to the demands of healthy progress. The university is expected in Great Britain to be (and *is*) tolerant of divergent opinions. It unites learned men of various philosophical outlook in a common effort to increase knowledge and to promote its diffusion through all classes of the community.

It must be incredible to British teachers that a judge charges a grand jury by reading out the first chapter of Genesis and declaring that that is the account of creation which Tennessee teachers must adopt. As a matter of *fact* that is *not* what the judge said. What he said was that, according to the law of the State of Tennessee, a teacher could not legally be paid his salary unless he taught the first chapter of Genesis as true. A Tennessee high school science teacher refused to give that teaching, and so has gained an enormous journalistic advertisement.

The whole affair is being worked by journalistic enterprise in the States on a misleading basis. There is no "trial" of the advertised teacher. He is no martyr. He is simply a case of the very ordinary failure of an employee who will not carry out the terms of his engagement and is dismissed accordingly. He is under no compulsion. He can teach according to contract or he can go elsewhere. He prefers to go. The interesting questions which remain for solution are: (1) Do the free and independent citizens of the State of Tennessee approve of the action of their legislature in regard to the first chapter of Genesis? (2) Will the Federal Court over-ride the interference of the State legislature in this special instance? It will take time to educate the citizens of Tennessee so as to enable them to judge whether their legislature is wise or foolish in endeavouring to exclude the teaching of the doctrine of evolution from State-supported colleges. We must wait and see. But in the meanwhile the great colleges of Harvard, Yale, and Princeton and the scientific academies and museums of the United States are not affected by this storm in a tea-cup.

P.S.—I should like to place on record the fact that at Oxford in 1873 I gave, as deputy of the Linacre professor of anatomy and physiology, a course of public lectures on "The Genealogy of the Animal Kingdom," in which I fully accepted and taught Darwin's doctrine of descent. Neither at Oxford nor afterwards when I gave a similar course of lectures at the Royal Institution in London was there the smallest protest or objection raised to the straightforward teaching of the doctrine of evolution and Darwinian zoology. On the contrary, I received warm encouragement alike from professors and undergraduate students.

Prof. E. W. MacBride, D.Sc., F.R.S.,
Professor of Zoology, Imperial College of Science and Technology, South Kensington.

The remarkable movement in America aiming at the suppression of the teaching of evolution in schools and universities is too widespread and has far too much momentum behind it to be accounted for as a mere outbreak of intellectual obscurantism. The general public there, as elsewhere, is profoundly uninterested in scientific speculation, unless this is discovered to have a practical bearing on life. It is because, in the opinion of the average American, the doctrine of evolution as taught in American schools and colleges is liable to defeat the purpose for which those institutions were established that he has risen in revolt against it.

The Fundamentalist argument is as follows:—These schools and colleges from which we desire to exclude evolutionary teaching were established by men brought up in the Puritan tradition, which has largely moulded and developed the American national character, of which we are all proud. The object for which these homes of learning were founded was not the imparting of abstract truth but the training of men to be good citizens. Evolutionary teaching in America has led to a purely materialistic and mechanistic view of life: it teaches that individual men are mere ephemeral bubbles on the surface of things: that their moral ideas are only tribal taboos of no particular validity: that "conscience and

free-will," to quote a leading exponent of "behaviourism," "are mistakes of the older psychology," that "God" and "Heaven," according to another evolutionary philosopher, "are defence-mechanisms different in degree but not in kind from the illusions of the paranoiac," and the widespread acceptance of such ideas would undermine the American character

The most practical objection to the Fundamentalist position is its entire futility Nothing could do more to stimulate widespread interest in evolutionary views than the attempt to prohibit them The American youth in particular resents being forbidden any of the fruits of the tree of knowledge, and the attempt to do so will only whet his appetite for them Just as hundreds of boys and maidens now indulge in whisky drinking who in pre-prohibition days never dreamt of such a thing, so it is to be anticipated that hundreds of youth who previously were entirely satisfied with cinemas and baseball will become evolutionists

The only way effectively to combat the mechanistic view is to build up a thorough and convincing idealistic criticism of it This is the path which has been followed in England, indeed few if any of the great Victorian scientists were blind to the enormous intellectual difficulties involved in a thoroughgoing materialism foi this reason Huxley, amongst others, wisely adopted the position which he termed "agnosticism"—freely acknowledging that problems of the relation of mind to body were entirely beyond the competence of science to solve Since Huxley's day, idealistic criticism has grown in strength, and so it has come about in Great Britain that all sorts and conditions of men, including reverend bishops of the Church and nonconformist divines, accept evolution, whilst still refusing to accept a mechanistic view of life and the universe We commend the consideration of these facts to Fundamentalists in America

Sir Arthur Shipley, G B E, F R S,
Master of Christ's College, Cambridge

The average American of the Middle and Southern States is a very naive mammal As a "prominent citizen" tells us in the current number of *The National Review*, the United States is a nation of adult children, and certainly some of the things they do seem to older and moie mature countries decidedly childish The farmers and the Methodist and Baptist pastors of States like Tennessee, Kentucky, Oklahoma, are really convinced that they can make a people moral and religious by enacting laws But the laws in America are so seldom enforced Before the War some eight or nine States passed a law by which all lunatics and criminals were to be sterilised, but I believe the law has only been observed in one or two cases Seven years ago I was sitting next to a very vinegary lady at Desmoines in Iowa She was jubilant over the Volstead Amendment, and said they would now tackle tobacco, and as soon as they had got that noxious weed out of the way, they would have a world campaign against the drinking of tea or coffee, both of which she understood contained poisons She closely cross-examined me as to whether the students at Cambridge were allowed to smoke, and when I told her that they were, and that I hoped they did, because we believed in the freedom of the individual, she became almost abusive But finally I silenced her by saying that she seemed so devoted to liberty that she wanted to take it away from everybody else in order to add to her own store

Now, in several States there is an attempt to control free thought In the Churches, America has scarcely passed beyond the region of the Presbyterian prosecution of Robertson Smith nearly fifty years ago They have heresy-hunts, again an attack on free thought The Ku Klux Klan movement is largely directed against certain forms of religious faith They are

> "Fightin' like divils for conciliation,
> An' hatin' each othei for the love of God"

But all the laws they pass can be and are evaded, and one has no doubt that in those States that have forbidden the teaching of evolution, evolution will still be taught Unfortunately, as a whole the people of these "sections" are not a reading people, and seldom soar above a light illustrated magazine, or they would read what they may not be taught The new text-book with which the Tennessee text-book commission has replaced the one used by Mr J T Scopes states, "In reference to all animals resembling man, none of them are to be thought of as a source of origin of the human species" But, after all, thought is free, in spite of Mr William Jennings Bryan, if one likes to think that man descended from animals resembling man, it will be very difficult to stop it

Of course, there is a great deal of money in these proceedings It will be the making of Dayton, where nothing has ever happened before and there is doubtless an expensive publicity agent with an itching palm The average European who has not seen it has no idea of the "lobbying" carried on by the more pushing publishers in the United States to get their books adopted Text-books are remunerative, and whoever has got the contract for these new biology books will probably make a very good thing out of it In the days of Henry Newell Martin, if he wrote a "Physiology" which was to be adopted as a school book by any State, he had to append a chapter on the

dangers of alcohol, otherwise it had no chance of being accepted As Kipling says of the American

Enslaved, illogical, elate,
He greets th' embarrassed Gods, nor fears
To shake the iron hand of fate
Or match with Destiny for Beers

Of course, now it does not pay to make beer in America, you must substitute synthetic gin for the last word of the couplet, but unfortunately synthetic gin does not scan

The Right Rev E W BARNES, D D, Sc D, F R S,
Lord Bishop of Birmingham

THE ignorant fanaticism which has led to the proscription of evolution in certain Western States of America is deplorable As one who values intellectual freedom I am shocked that Anglo-Saxon communities should seek by legislation and prosecution to prevent the spread of knowledge As a Christian I am dismayed by a movement which opposes a reasonable formulation of the Christian Faith Cumulative and well-tested evidence has convinced every reputable biological expert throughout the civilised world that man has evolved from an ape-like stock The normal educated Christian in Great Britain regards the process of evolution as the machinery by which God has created man Every divine of any eminence among us accepts this point of view Such acceptance strengthens the Christian position, for it makes the spiritual interpretation of the universe which we derive from Christ more convincingly reasonable

No part of the teaching of Jesus, as set out in the New Testament, can by the most ingenious sophistry be held to imply belief in the literal truth of the Genesis account of creation The "Fundamentalists" forget that the Bible is a spiritual treasure-house, not a scientific manual They ignore the Christian doctrine that the Holy Spirit is still at work among men, leading them to an ever fuller understanding of truth, with a fear that is really anti-Christian, they assume that a fuller knowledge of truth will weaken rather than establish the Christian revelation The inevitable result of their attempt to repudiate sound science in the name of religion will be that tens of thousands of college boys and girls in America will repudiate Christianity in the mistaken belief that it is bound up with pitiable ignorance

In England the battle was fought out more than a generation ago From the blind religious prejudice of men like Pusey, Samuel Wilberforce, and Gladstone (why do political leaders damage their fame by theological obscurantism ?) we were mainly saved by the enlightened boldness of the Victorian liberal divines, of Archbishop Temple, of Frederick Denison Maurice, who was never tired of quoting the spirit of Darwin's investigations as a lesson and a model for churchmen, of his friend Kingsley, of Bradley, the Dean who buried Darwin in Westminster Abbey, of Farrar, who preached his funeral sermon, of Canon Wilson, who still survives in honourable old age But without such men the truth would have prevailed It will prevail in the long run in the United States Of what avail was it that the Roman church placed heliocentric treatises on the Index of Prohibited Books ? The earth moves and the mind of man moves also to embrace an evergrowing understanding of the mystery of creation

Prof W J SOLLAS, Sc D, F R S,
Professor of Geology, University of Oxford

THE action of the State of Tennessee raises a number of questions which it would be interesting to discuss were it not that they are all subsidiary to the one which agitates the minds of all freedom-loving peoples, *i e* the right of the State to suppress the teaching of scientific truths On the subject of evolution there is, I believe, among competent thinkers but one opinion To put it in a form that will be readily understood by our Puritan friends, all zoologists and botanists are agreed that the creation of species, including man, proceeds or has proceeded by way of evolution This a theory which might almost be regarded as a fact, it is so widely and surely based that it might be ranked as of equal certainty as the revolution of the earth around the sun, a subject which supplies an interesting parallel with the present one if only we substitute Papists for Puritans

But all endeavours to suppress a truth are as futile as they are false If natural history is to be taught at all in the schools, then in the end the truth will out The structure, functions, habits, and distribution of animals and plants are, it is true, subjects of such absorbing interest that lessons upon them, from which all theory is carefully filtered off, are sufficiently attractive in themselves to arrest the attention and engage the studies of a class, but the interrelation of the facts they disclose must inevitably suggest many searching inquiries, and curiosity once aroused will not rest satisfied until it has received an answer Then, if we are really back in the days of the Inquisition, the next step which will devolve upon the State will be the institution of an Index Expurgatorius Short of this the truth will no longer rest concealed

We reach, then, a stage when the community will arrive at a knowledge of the facts of evolution Then comes the question—What about its explanation ? There we are on very different grounds It is no secret that Darwin's explanation no longer occupies

undisputed possession of the field, and there are without doubt many distinguished investigators who freely admit that a satisfactory explanation has yet to be found. For myself, I confess that I regard the Darwinian explanation as only a half truth, and I think that the discussion of this question requires wider knowledge and greater maturity of judgment than the schools are likely to provide. It should be left to the universities, and even then the implications of all evolutionary theories should be carefully borne in mind, for the effects of some of them, if rashly introduced into ethics, personal, social, or political, might prove to be disastrous in the extreme.

SIR ARTHUR KEITH, M.D., F.R.S.,
Hunterian Professor and Conservator of Museum, Royal College of Surgeons of England.

IT is in no spirit of levity that I, a life-long student of the human body, would quote here, for the benefit of Fundamentalists, both at home and abroad, a saying of that Master whose teaching they claim to follow: "Father, forgive them, for they know not what they do." For if their desires are fulfilled, the teaching of anatomy will become a colossal system of organised hypocrisy. In every sentence of his lecture, a professional anatomist, who is compelled to base his teaching on the first chapter of Genesis, must sin against the truth which is in him. If the teaching of evolution is proscribed, then the study of the development of the human body must be forbidden by law, for in its development the human body proclaims that evolution is true. Dissection will have to be forbidden; for every one, be he teacher or student, who dissects man's body and compares it with that of apes and of monkeys, has the same truth forced on his perception.

Only penal servitude for life will keep men from searching the records of the rocks and discovering that the earth itself has kept a detailed history of plant, beast, and man, and all of these records shout aloud that evolution is true. All the fossil remains of primitive man, of beings who are almost as much ape as man, will have to be destroyed and all written description of them obliterated if Darwinism is to be undone. The stone implements of ancient man, which have been gathered with such meticulous care from recent pages of the earth's history, will have to be gathered together and solemnly carried to the deepest sea and there sunk. For these silent witnesses carry the history of man and the history of woman tens of thousands of years beyond the days of Adam.

Archæologists must be forbidden to enter Egypt and Mesopotamia, for they are carrying history further back than the Bible allows. Astrology must replace astronomy; alchemy, chemistry; children must be taught that the sun and moon revolve round the earth, if the Bible is to be standard text-book of the modern teacher of science.

Men who propose to bring about such a change "know not what they do." They do not know the world they live in. For what they have set out to do is to turn the hand of the clock of progress back to a point it reached four thousand years ago—to a point when teachers of anatomy assured their students that woman was made out of Adam's twelfth rib. If Fundamentalists push their proposal to the point of practice, they will certainly smash the "rock of ages" but they will leave unharmed the "record of the rocks."

Prof. G. ELLIOT SMITH, M.D., F.R.S.,
Professor of Anatomy, University College, London.

THE proscription of the teaching of evolution in any university cannot fail to destroy the influence and in fact the very existence of such an institution. For the purposes of a university are to advance and diffuse knowledge and to inculcate the discipline of the search for truth. To deny it the freedom to cultivate these objects is to eliminate its right to exist.

Such action can do no harm to the theory of evolution; nor can it stifle the spirit of truth. But it does reveal the depth of ignorance and stupidity of those who assume that it is possible in the twentieth century to suppress intellectual freedom and to eliminate the spirit of honest inquiry from any community. Moreover, the ignorance is not merely of science but even more of the lessons of history. This campaign for fettering intellectual pursuits has been pursued with a variety of excuses for more than three centuries. In spite of ephemeral triumphs it has invariably ended in disastrous defeats, injuring the misguided fanatics themselves far more than the cause of truth they are trying to stifle. For it is clear the Tennessee comedy is not concerned primarily with evolution: it is essentially the three-century-old attempt to destroy intellectual freedom. The denial of evolution now occupies the place that even so recently as fifty years ago certain theologians assigned to the claim that the earth was flat and fixed in space.

But the reality of evolution is as certain as the fact that the earth revolves around the sun. The former is as essential a part of all modern biological thinking as the latter is of astronomy. Hence the change of the issue does not help those who are stupid enough to imagine that the fact of evolution can be suppressed.

In 1615 Galileo was summoned before the Inquisition, which unanimously declared his proposition that "the sun is the centre and does not revolve about the earth" to be "foolish, absurd, false in theology, and heretical, because expressly contrary to Holy

Scripture" In spite of repeated humiliations, certain theologians (and especially those in the Southern States of America) only finally abandoned these claims that did infinite harm to their own cause less than fifty years ago The substitution of the biological for the astronomical issue can only result in adding vitality to the ridicule that is certain to overwhelm these misguided people, who know not what they do

Prof W C McIntosh, D Sc, F R S,
Emeritus Professor of Natural History,
University of St Andrews

Trained from early days in biology on the shores of the rich Bay of St Andrews under William Macdonald, George E Day, and Miss Otte, the translator of De Quatrefages' "Rambles of a Naturalist," and later under George James Allman and John Goodsir in Edinburgh, before the appearance of the "Origin of Species," it has been my fate to witness all the vicissitudes of support and opposition (often with personal knowledge of the men) to which this epoch-making work gave rise Close occupation in zoology and a disinclination to theorise have prevented personal work in a field so fascinating and so fruitful to many, yet such could not check an impartial judgment of the facts In Great Britain about fifty years ago, it is true that the leanings for and against evolution were each in turn keenly opposed in elections for certain university chairs It is long, however, since such straitened views have disappeared, and men of every grade of opinion on the subject have been dispassionately chosen on their real merits, and perfect freedom of opinion afforded to university and other teachers This experience has not resulted in the lowering of the esteem for what is good, nor has it altered the value of the Bible or of religion, nor has it undermined the moral principles and character of the nation—upon which so much depends

The breadth of view and the great impetus the evolutionary theory has given to the study of the natural sciences cannot be denied Its value, for example, is of the greatest importance in grasping the relationships of fossil and recent types of every class, from the simple Palæozoic forms to those of the Pleistocene period Knowledge is a universal goal, and scientific knowledge especially cannot be hampered by restrictions, however well intended It seeks truth only and labours long to find it The teaching of evolution in schools and colleges of the United States was perhaps unknown to many in Great Britain, but the veto of some of the American States authorities against such teaching seems to carry us back to the Middle Ages, when free thought and conviction on certain subjects were fraught with violent opposition and danger I do not hesitate, therefore, in joining my scientific colleagues in protesting against this infringement of freedom of thought—affecting responsible officials of high character in universities and schools of the United States

Rev Hilderic Friend,
Wesleyan Minister

My biological researches commenced close on half a century ago, when the Churches were almost all strongly opposed to Darwinism My bias, therefore, was, from the outset, against the theory of evolution Yet every step taken in the study alike of botany and zoology, of anthropology and religion, tended to show me that the secret of life was to be found, if anywhere, along the lines of evolution, and there was no other theory in the field which could meet all the difficulties involved in the mystery of life Genesis states a fact, evolution attempts an explanation

As a student of divinity, long familiar alike with the idea that science and religion were in conflict, and that the doctrine of evolution intensified the supposed antagonism, I have found in that doctrine the most satisfactory solution of my problems as a teacher I owe much also to the fact that, in my plastic years, I resided in the East, and became familiar with Oriental imagery and modes of thought

I find the doctrine of evolution in fullest harmony with all that I have been able to discover by practical study of Nature and comparative religion, as well as by personal experience While I have the highest respect for law and order, I cannot but wonder that the making of laws relating to the education of the race should be in the hands of men so reactionary and ill-informed, men who have failed to learn anything from the past All history teaches us the unwisdom of opposing new modes of thought Christ had to insist on a revision of the Mosaic law, as being out of harmony with the thought of the age, and time has in fullest measure justified his action The Church in vain attempted to suppress the teaching of Galileo If this thing is of men (as a wise man once remarked) it will come to nought, but if the doctrine be true it cannot be overthrown The truth will prevail Nothing can be gained, and much will inevitably be lost, by any attempt to enforce legislation against the teaching of evolution

It must, however, be conceded that much present prejudice and misunderstanding is due to the want of thought and tact often displayed by propagandists For the future, in order to obviate these things, the teaching of science as well as that of religion must be entrusted to our wisest, best, and most carefully

trained educators Whatever of error there may then be in their teaching will eliminate itself and the doctrine of evolution may safely be left in their hands to establish itself if it be true, to develop and unfold if it be imperfect, or to perish if it be false

F A BATHER, D Sc, F R S,
Keeper of the Department of Geology, British Museum (Natural History)

THIS medieval gesture is curiously half-hearted Complacently to accept the material benefits of research and to reject the intellectual results, to prefer the electric light to the light of reason, the loud-speaker to the still small voice of the spirit this is worse than a frank return to the Dark Ages But the attackers of evolution have apparently never considered what is meant by it Possibly some of its defenders also have not considered The attack at any rate is confined to organic evolution (atoms and automobiles may evolve as they please), and the spear-point of it is directed against the statement that man is descended from the anthropoid apes Few would accept so crude a statement nowadays, but any statement that zoologists could substitute for it would, no doubt, be equally objectionable

Education, however, is the field of battle, and a teacher may perhaps grant something to the other side Evolution is a theory of creation There are other theories, and some of them, held by thousands of well-meaning people, may not be taught in the State schools of certain countries Perhaps it is just as well not to teach any theories A teacher who is not himself an investigator is liable to be too dogmatic and to bring forward a theory as a ready-made explanation of matters which he is really (like the rest of us) unable to explain The right of free thought and free speech is one thing, the guidance of the young is another

As a palæontologist I should be quite prepared to teach facts, leaving their philosophical interpretation for later years The intelligent among my pupils would probably come to the same broad conclusion as all palæontologists have come to, and they would have had a better intellectual training than if the theory had been forced into them

Are not the Americans a little too ready to substitute theory for fact in their educational courses? Perhaps this attack is the inevitable reaction, and it may prove not unwholesome It would do us all good to drop "that blessed word Evolution" for fifty years

The controversy will be entertaining and a boon to the newspapers, but is it seriously supposed that all the eminent biologists in the world could convert Mr Bryan and his friends? As easily would President Osborn convert Mr Bateson to his particular belief

D H SCOTT, D Sc, F R S,
Lately Honorary Keeper of the Jodrell Laboratory, Royal Botanic Gardens, Kew

THE resuscitation, in certain of the United States, of the old "Science *v* Religion" conflict is a curious and interesting phenomenon, which need not seriously disquiet the scientific world The Fundamentalists are quite right in holding that a belief in evolution is fatal to their own stereotyped form of religion If religion is to be wholly unprogressive, then science also must be kept stationary, otherwise a collision is inevitable, and science is bound to get the best of it in the future, as she has constantly done in the past

The surprising point about the American conflict is that it has come so late Sixty years ago, when Darwinism was young, we were quite accustomed to this kind of antagonism in England, though it does not appear that we ever went so far as to prohibit the teaching of the new doctrines

It may be doubted whether, among scientific men, there are any now living who reject the theory of descent From a biological point of view this is, in fact, the only theory in the field, for the old doctrine of special creation was no more than a confession of ignorance To account for the origin of species by asserting that species were created by the Deity is as if we were to attribute the origin of the Himalayas to the act of God, instead of trying to find out how and by what forces their elevation was accomplished

It is probable that those who dislike evolution may have been misled and unduly encouraged by the recent frank statements of some eminent biologists, who have acknowledged how little we know of the methods of evolution The difficulties are no doubt more fully realised now than they were a quarter of a century ago But Mendelism and its implications no more cast doubt on the reality of evolution than the theory of relativity invalidates the discoveries of Copernicus

Of late years I have often had occasion to direct attention to the difficulties in tracing the course of evolution in the plant world The problem is extremely involved, and many questions must be left open None the less, the general conclusion that the past history of plants, like that of animals, is nothing but the record of an evolutionary process, remains firmly established

REV FRANK BALLARD, D D,
Christian Evidence Lecturer for the Wesleyan Conference

IT is difficult to write with judicial calmness concerning the state of affairs exhibited by the approaching "trial" of Mr J T Scopes for teaching evolution in

the Tennessee High School. The assumptions of Fundamentalism are so preposterous, alike in theory and in practice, I am not altogether surprised, when I call to mind my experiences in America a quarter of a century ago. It was pitifully manifest then, that both in science and theology, many of those who posed as authorities were half a century behind the times. But one did hope that the intervening years would have opened their eyes. The notion of a Judge's charge to a grand jury beginning with the reading of the first chapter of Genesis—"as the account of creation which Tennessee teachers *must* adopt"—of course in the Fundamentalist sense—savours of the sixteenth century rather than the twentieth.

In view of the whole case, there are two questions which loudly call for unequivocal answer. (1) The first is whether universities are to be free to teach what is true, in the light of advancing knowledge, or are to be for ever throttled by the grip of theological obscurantism. Unless this latter alternative be met with an overwhelming negative, humanity must simply drift back to the miserable darkness of the Middle Ages. (2) The other question is whether the view of creation, with all its consequences, which is dogmatically insisted on by Fundamentalists, is so true that nothing more remains to be learned.

It is not too much to say that, in these days, every child in a respectable school knows that it is not. Whatever room and need there may be for the correction of Darwinism, and the re-statement of evolution in the light of our latest knowledge, this certainty emerges, as plainly as the light of dawn after the dark, that the "creationism" which pivots itself in the opening chapters of Genesis is wrong; and its inferences are as false as they are dangerous, as mischievous as they are dogmatic. Neither God nor man is such as the Fundamentalist shibboleth declares. To say nothing of palæontology, biology, and embryology—save that they cannot now be extinguished by ecclesiastical anathemas—every Fundamentalist bears about in his own body a hundredfold proof that his main contention is untrue. That ought to suffice, not only for all the twenty thousand who are to fill the stadium for the "trial" of July 10, but also for every sane and sincere man or woman on earth.

W. Bateson, D.Sc., F.R.S.,
Director of the John Innes Horticultural Institution, Merton, Surrey.

I am glad to add a few words to what I wrote in Nature of September 1, 1923, p. 313. The Tennessee trial is something more than a curiosity in the history of civilisation. Wherever science and learning are valued, sympathy with the unfortunate victims of this new persecution will be unanimous and deep. They suffer in the cause of truth, if ever men did. To them personally we trust that at least some restitution may be made.

None of us can, however, be indifferent to the issues now being raised on a great scale for the first time in the modern world. The opinions of Tennessee and similar communities respecting the evolution of animals and plants would not seem to be a matter of general concern, but the symptom is really one of grave trouble, and the tremor now perceptible is an indication of a strain in the social fabric which sooner or later may end in catastrophe. To the nineteenth century, the dissemination and inculcation of scientific truth wholesale was an object almost as desirable as actual discovery. The fundamental and permanent heterogeneity of the population was not appreciated as a fact of any consequence. With education it was expected to disappear. Nothing of the kind has happened. If the true convictions of our own people could be ascertained, I do not suppose they would be found to be very different from those of Tennessee. We are fortunate in having a somewhat larger proportion of the rarer elements as an ingredient in our population—men whose minds are as Plato might have said, "released"; but they are a mere fraction in any community, and it is a miracle that they are able to impose a precarious authority sufficient to protect themselves from molestation.

Upon the still larger considerations which lie behind, we, as scientific men, are not required to pronounce. Whether a State stands to gain or to lose by the encouragement of intellectual freedom in comparison with others which control or suppress truth is a problem on which political philosophers have exhausted the arts both of eloquence and sophistry. No universal solution, independent of time and place, can be expected. But one thing is certain: that to us our liberty is vital; and to suppose that movements of this magnitude in the United States have no significance for ourselves is to cherish a very dangerous illusion.

Sir Sidney Harmer, K.B.E., D.Sc., F.R.S.,
Director of the Natural History Departments, British Museum.

It is difficult for those of us in Great Britain who have recently taken part in the centenary celebrations held in honour of Huxley, the champion of intellectual liberty, to realise the consequences of a successful attempt to control scientific thought, or to believe that a result of that kind is possible in a great country like the United States, which has always prided itself on being the home of freedom. The danger is, however, a very real one on the other side of the Atlantic, and our scientific colleagues there who are fighting the battle can count on the unanimous support of workers on this side.

Considerable harm has been done in America by the failure to realise that a want of agreement as to the causes of organic evolution does not imply any difference of opinion with regard to evolution itself. The evidences for the origin of animals and plants as we now see them, as the result of evolutionary processes, seem to us, as to our distinguished co-workers who stand for intellectual liberty in America, too plain to be doubted. Even if, like Malvolio, we did not approve the opinion of Pythagoras, we should think too nobly of the soul to wish to convert an honest conclusion on the subject into a legal offence.

Among those who are qualified to speak in Great Britain there can be only one opinion: that the attempt to limit the advance of scientific thought is intolerable. History is full of examples which show that progress cannot be stayed, even if it can be

temporarily arrested It may be anticipated that the principle which is so much feared by a section of opinion in the Southern States will ultimately triumph over its opponents, by the inexorable evolution of a more rational attitude of mind In the meantime, much harm may be done, and it may earnestly be hoped that the supporters of a policy of intellectual slavery will be defeated

Ernest Barker, D Litt,
Principal of King's College, London

How far can the public opinion of a State, expressed through its legislature, claim to control the curriculum or the teaching of universities or schools? It would seem to me that any State may demand that this or that subject should be taught in any place of instruction which is supported from public funds, but that no State is entitled to prescribe what should actually be taught about any subject The reason is simple The aim of all teaching is to awaken and train intelligence No teacher can awaken or train the intelligence of his pupils unless he is using his own intelligence freely If a teacher teaches what he is told to teach, he teaches by rote a lesson which his pupils learn by rote Without freedom, he is also without self-respect, without self-respect, he cannot earn the respect of his pupils, and failing to earn the respect of his pupils, he fails to produce any effect upon their minds All education depends on the free contact of a teacher, teaching spontaneously, with pupils who are attracted by the suggestion of his teaching and drawn thereby into study on their own account No man can draw others to himself unless he is speaking from himself

The very genius of liberty which inspires representative bodies, and is the breath of their own existence, must prevent them from killing the genius of liberty which inspires places of education and is the breath of *their* existence A legislature cannot be told what it is to legislate, a university cannot be told what it is to teach Public opinion is a great thing, but there can be no healthy public opinion without discussion, and no genuine discussion without a genuine and free education If a legislature tries to kill liberty of teaching, it stultifies itself—based as it is itself on freedom of speech If public opinion seeks to stifle freedom of thought and expression, it commits suicide, for public opinion can only be formed by freedom of thought and expression A democratic State cannot kill liberty or stifle freedom of thought without killing itself and stifling the breath of its own life

Prof D'Arcy Wentworth Thompson, C B, F R S,
Professor of Natural History, University of St Andrews

When the wiseacres of the backward States, with their true herd-instinct, take to quarrelling over whether evolution should be taught or no, it is some consolation to think that worse mischief might perhaps be found for such idle hands as theirs to do If they did no more than forbid the teaching of evolution in their elementary schools, I should even be inclined to agree with them, for I feel myself none the worse that no schoolmaster ever dreamed of teaching Darwinism to me, nor has it ever been among the lessons which my own children learn Few schoolmasters are really fit to teach it, and children have other fish to fry

That these good people should insist on setting the Book of Genesis against the "Origin of Species," and should hate the one as they love (or profess to love) the other, is a sadder thing The lessons of the last sixty years, the philosophy of evolution itself, should help us all to appreciate them both, and to see in the Mosaic cosmogony as noble a poem as ever was in all the world, and a living monument of profound wisdom and very ancient science The longer I live the more beautiful it seems to me,—the more beautiful and the more vitally and essentially true The child cannot understand it all, who is there that can? But if it be withheld from him, he is robbed of part of his heritage

When democratic licence lets these foolish and fanatical men impose their folly on the universities and play havoc with the public libraries, then our American friends and we ourselves may well be dismayed Dr H F Osborn and his colleagues are smarting under insult and injury, but the protest they have drawn up is moderate in tone and faultless in expression I admire the restraint they display under the gross provocation they have received What they want (but they are too courteous to say so) is "a bridle for the ass, and a rod for the fool's back"

Rev Eric S Waterhouse, D D, M A,
Wesleyan College, Richmond, Surrey

The action of certain American states, which have set a ban upon the teaching of Darwinism, is evidence of a curious but frequently-noted fact that, in theological matters, the newer countries are more reactionary than the old The great majority of clergy and ministers in Great Britain accept the theory of the evolution of species It has appeared within recent years that some of Darwin's positions are not likely to be sustained, especially as regards the importance he attached to the accumulation of small variations, and to natural selection But the main position of the evolution of species, as against the doctrine of the special creation of "natural kinds," is well-nigh impregnably based

Modern Christianity understands that the cause of truth demands absolute freedom of research and statement The basis of all scholarship is the belief that truth can be attained Religion must hold that what is true cannot possibly conflict with it Unfettered search for truth will involve that mistakes are made and errors are accepted as true But the same process will in time provide also the remedy Those who hold that Christianity is true should also hold that no scientific or philosophical truth can be detrimental to it, even though such truth may upset ancient dogmas Conversely, it follows that anything set forth in the name of science or philosophy which is incompatible with those broad truths to which man's religious experience bears witness is to be suspected Surely ultimate truth must be such as satisfies all our values, intellectual, moral, æsthetic, and religious

Prof J Graham Kerr, F R S ,
Regius Professor of Zoology

The fact of evolution is one which is now verifiable by the student of even elementary embryology, who can observe for himself the successive stages by which any one of the higher animals evolves out of the simple unicellular zygote In the case of man himself it can be seen that he is for a time provided with gill-openings in the sides of his neck and that he has other temporary peculiarities which would justify his being classed with fishes were only his embryonic structure known That the process of evolution was characteristic of the past history of the race, as it still is of the individual, is shown by many paragraphs of geological history—the most beautiful of them all being that provided by the rocks of the American continent chronicling the evolution of the skeletal peculiarities of the modern horse The only persons who can at the present day have honest doubts regarding the broad facts of evolution are (1) those who are ignorant of such facts as I have indicated and (2) those whose conception of God permits them to regard His records, as inscribed in the rocks and in the embryonic body, as a whimsical series of deceptions If the legislators of Oklahoma and Tennessee belong to the first of these categories, their opinions may be expected to change with inquiry—and I would indeed recommend such inquiry into the facts of Nature as a charming and delightful relaxation from their legislative labours—but if they belong to the second there is, I fear, little hope of modification of their strange, and as they appear to me, somewhat pagan doctrines

No doubt it might be argued that the main point at issue is not whether evolution is a fact but rather whether thought is to be subject to the control of authority We have seen of recent years manifestoes exemplifying such control—emanating it may be from Berlin, or from Moscow, or from Pekin, or it may be promulgated by the governing council of some social or industrial organisation The effects in the way of hatred and war that are liable to result from such policy have been so amply demonstrated in the past, and are so clearly apprehended for the future, that I find it difficult to believe that its open adoption will find any considerable body of support in the United States

Prof R C Punnett, F R S ,
Arthur Balfour Professor of Genetics, University of Cambridge

To one who has never set foot on the American continent, it is difficult to suggest the real meaning of the curious outburst against freedom of thought which has made its appearance in the Southern States That it is anything more than a sporadic phenomenon is hard to believe The firm outer crust of civilisation which has gradually set through the long centuries may at times show local disruption, especially in lands with little tradition of disciplined thinking Where the will to ignorance exists, the forces of obscurantism may from time to time break out with sudden violence, but that they will ever engulf the globe seems a possibility as remote as the return of the solar system into the nebular phase After all, it is in his powers of reasoning that man differs most from other animals, and without them he could neither feed nor clothe himself

This inherent capacity for rational thinking, without which daily life would be impossible, is surely a sufficient guarantee that obscurantism in the long run will never prevail If we admit so much, it is all to the good that the greatest possible publicity should be given to the trial of Mr Scopes It will lead to some interest in these matters on the part of millions to whom, at present, evolution is nothing but a longish word that sometimes appears in a cross-word puzzle It will bring them into contact with facts, which are at once the best stimulant to curiosity, and the best antidote to obscurantism Let us therefore hope that the combined enterprise of the newspapers, railways, and cinemas will lead to the erection of an even larger stadium than that proposed Though the lawgivers of Tennessee may make the angels weep, they hold out a promise of infinite entertainment to a world that is often rather bored with life

F A Dixey, D M , F R S ,
Subwarden, Bursar, and Lecturer of Wadham College, Oxford

The growing agitation against the teaching of evolution in several of the states of the American Union is nothing less than astonishing If there is anything whatever that is well established in the conclusions of natural science, it is the general doctrine of organic evolution The details of the evolutionary process are still matters of legitimate discussion, but as to the main fact that the present aspect of organic nature is the result of evolution, there is absolutely no question among those who are competent to form an opinion on the subject But even if the doctrine rested upon a less assured foundation of observation and research than is actually the fact, it is no less deplorable that in a civilised country like the United States an organised attempt should be made to check the process of inquiry into the truths of Nature Whatever excuse there may have been in former ages for limiting the scope of free investigation, and for visiting with penalties those men who ventured to bring their powers of reasoning and observation to bear upon the conclusions sanctioned by authority, no such excuse or palliation exists at the present day

The futility of all efforts to impede the progress of scientific discovery has been amply demonstrated, and it might have been supposed that this would have been brought home to the consciousness of all but a few fanatics That the reality is far otherwise has unfortunately been made fully apparent by the activities of the Fundamentalists in the Southern States of America, and it must be recognised that the forces of obscurantism have increased in certain parts of the North American continent to a pitch which actually constitutes a public danger The fullest sympathy is due to those men of science in the United States who are striving to rescue their country from the reproach of hostility to the cause of truth and knowledge

Prof J COSSAR EWART, M D, F R S,
Regius Professor of Natural History in the University of Edinburgh

THE coming trial of Mr J T Scopes reminds one of the case of Prof Robertson Smith, whose articles on Biblical subjects half a century ago greatly distressed and alarmed the authorities of the Free Church of Scotland Professors in the Free Church Colleges were required before induction to sign the Confession of Faith, which implied, amongst other things, that they would be guided in their teaching by the first chapter of Genesis After full consideration, Robertson Smith's articles were adversely reported on by a committee of the General Assembly of the Free Church, with the result that he was removed from his chair in the Aberdeen Free Church College According to Sir Arthur Shipley, the fight made by Robertson Smith for intellectual freedom made him the "most popular if not the most powerful man in Scotland"

There is no evidence that during Darwin's lifetime any professor in the Scottish universities lectured on the doctrine of evolution, but since 1882 the evidence in support of the origin of species by natural selection has been frequently dealt with by teachers in Scotland It is doubtless true that for some time in Scotland Darwinism was regarded by some as an "unpleasant apparition" This may be partly accounted for by the fact that in 1882 the president of the Royal Society of Edinburgh was a Scottish judge who had no interest in biology, and partly by the presence of several clergymen on the Council Fortunately, largely by means of courses of lectures in the University of Edinburgh, on the philosophy of natural history, by the late G J Romanes, the alarm which for a time prevailed all but subsided, that any opposition that existed has almost entirely died away was made evident by the popularity of Sir Arthur Keith's recent lectures in Edinburgh on the "Story of Man's Evolution as told by his Fossil Remains"

E N FALLAIZE,
Hon Secretary, Royal Anthropological Institute

THE attempts to discourage the study of evolution which have been made in certain legislatures of the United States, as well as the impending trial in the State of Tennessee, have naturally aroused considerable interest among anthropologists in Great Britain A ban on evolution would virtually affect the progress of anthropological science not only in so far as it affects the origin and descent of man, but also as rendering meaningless the conception which serves to give unity and direction to the study of human culture as a whole The importance of these studies in relation to the general advancement of knowledge needs no emphasis, while any system of higher education which omits to take into account the systematic study of man and his culture is deprived of one of its most important elements as an educational discipline A generation growing up under a scheme of education thus mutilated would find itself cut off from the general stream of intellectual progress and isolated from the culture of the remainder of the educated world

On the general question of the relation of the State to scientific inquiry, it is impossible not to deplore a movement which seeks to fetter individual freedom of thought and investigation, and at the same time attempts to justify such interference by submission of the questions at issue, not to a scientific tribunal, but to a court composed of laymen without scientific training, and governed by rules of evidence which have no validity in scientific investigation Should the obscurantist influences which have promoted this action in the State in question prove strong enough to carry the day by force of numbers, the result will appear derisory to the rest of the civilised world, but unfortunately it will deal a disastrous blow to science in the United States, and indirectly to scientific investigation as a whole throughout the world

Prof SYDNEY J HICKSON, D Sc, F R S
Professor of Zoology, University of Manchester

A LITTLE while ago a student in my class took the opportunity which an examination afforded to dissent from, and to criticise severely, a view which I had expressed in my lectures

I took the line of action which I think all my colleagues in this country would have taken of giving him a mark for his answer irrespective of the views he expressed, suppressing an inclination I felt to mark him a little higher for the courage he showed in dissenting from the views held by his examiner

In a university where the teachers are free to teach, the students must be free also to accept or reject the theories they are taught Suppression of free teaching must lead to suppression of free learning The students will leave their high school or university trained in the belief that the theories and conceptions of the universe they have learned are true and that anything else is false This can only lead to a form of mental stagnation in the generation which it is our duty not only to instruct but also to stimulate to search for truth in the wide fields of science

In the correspondence which has been published about the Tennessee State law on the teaching of evolution, a great deal has been written about the importance of the liberty of the teacher With all that we must cordially agree But let us also plead for the liberty of the taught Let us insist that in a free country the young men and women should be trained to think, encouraged to discuss, and free to form an opinion The dogmatic teacher produces dogmatic pupils, and a State that insists upon dogmatic teaching produces a race of citizens deprived of that liberty of thought which is essential for its progressive development

Prof J STANLEY GARDINER, F R S,
Professor of Zoology and Comparative Anatomy, University of Cambridge

IN all ages and in all climes men have striven for truth, and in the march of progress men have attained no step after more persistence and suffering than the right to a free utterance of the truth that in them lies Real religion and science have in common this passion for truth, eternal and indestructible In its search for truth, science begins with the demonstrable

facts, and from these humbly and gratefully draws conclusions These are not in the nature of permanent dogma, and, as more evidence is attained, further conclusions are drawn

Let legislators, who ban the teaching of evolution, think what they are doing, and, above all, whether they will not defeat their own ends The technique of all teaching prepares the ground for theories of evolution The biologist teaches facts, but the road for the student has already been paved, and the latter naturally strings these facts together in an evolutionary form I know no professor of biology who requires to teach the broad theory of evolution, for, with a little knowledge of facts, his students, universally and of their own initiative, deduce it for themselves What the professor does is to discuss how evolution may have come about, its extent and its limitations, endeavouring thereby to teach his students to think logically, that is, sanely Applied to life his students find that they have learned the principles, not of militant atheism and communism, but of sane and orderly progress, on the due understanding of which depends the prosperity of States Let those in authority think well of the advice of Gamaliel "If this counsel or this work be of men, it will come to nought but if it be of God, ye cannot overthrow it, lest haply ye be found even to fight against God"

EDWARD CLODD

THE savants of America need no assurance from their brethren on this side of the Atlantic that they are as one with them in their struggle to maintain the liberty of thought and its expression which are the instruments of progress, the legal suppression of which is the aim of the so-called Fundamentalists That the theory of evolution is based on a bedrock of facts unshakable has no weight where passion, prejudice and ignorance impel undisciplined emotion Hence, to this type of mentality, reason appeals in vain Against this are cited the contents of a miscellaneous collection of ancient writings of uncertain authorship, age and meaning, the interpretation of which has riven Christendom into hundreds of "warring sects" We may envy the Greeks of old, of whom, in his brilliant "History of Freedom of Thought," Prof Bury says, they "fortunately, had no Bible, and this fact was both an expression and an important condition of their freedom"

The attitude of these obscurantist heresy hunters is clear enough They hold that belief in evolution imperils the souls of men, hence the fanaticism which would prohibit its teaching To these malignants no quarter can be given their fictions and fallacies "debase the moral currency" It cannot, as W K Clifford says, "be true of my race and yours that to keep ourselves from becoming scoundrels we must needs believe a lie"

Prof ARTHUR SMITHELLS, C M G, F R S,

Emeritus Professor of Chemistry, University of Leeds

THE control of education by political or sectarian authority must always involve potential danger to intellectual freedom, but it costs an effort to believe that, at this stage of human history and in the New World, we are in the presence of a serious threat on the part of popularly elected State authorities to use political law for suppressing knowledge of the laws of Nature

It is to be hoped that the intellectual world of the United States will rise to the occasion, and that its members will undergo any kind of martyrdom rather than tolerate so great a scandal They may be assured of the sympathy and support of multitudes in every civilised country in resisting this extraordinary recrudescence of a type of persecution which was thought to have passed away for ever with the Dark Ages

The universities, above all, will be called upon to fight on the side of freedom, and it seems inconceivable that they can show any timidity or any willingness to traffic in compromise The first rights of a teacher, the cause of science, the dissemination of truth, are assailed once more by bigotry and fanaticism in the seats of authority It seems superfluous to insist upon the importance of the issue or on the need of an unqualified victory over the powers of darkness

In recent times voices have been heard proclaiming the doom of our modern civilisation Let learning go into captivity, and surely enough these prophets of evil will be justified!

Rev J SCOTT LIDGETT, D D,

Warden of the Bermondsey Settlement, London

THE agitation about the teaching of evolution in the United States raises most important political, scientific and theological questions In regard to them all the controversy appears to me to be disastrous For a State legislature to attempt to decide questions of scientific evidence is fatal to the interests both of truth and freedom It extends the authority of the State to realms quite beyond its legitimate province, and carries us back to the Middle Ages From the scientific point of view, the contention that the doctrine of evolution is a "mere guess" is to show complete ignorance of the immense body of facts that have been ascertained, and of reasoning that is securely based upon these facts What is most injurious of all, however, is the supposition that the truth of Christian Theism depends upon any particular hypothesis as to the method of divine action in creating, or constituting, and in sustaining the universe The philosophy of Theism is much profounder than this To many Theists, the attempt to treat God as so external to the universe that His action can only be explained as that of Omnipotence acting upon it from without by mere acts of will, is to run counter alike to the deeper teaching of Scripture as to the organic relation of God to His World, to the deliverances of religious experience properly interpreted, and to any satisfactory philosophy of Theism It represents the doctrine of Deism, and not of Christianity

Rev A F DAY, S J,

Church of the Immaculate Conception, Farm Street, London

ALTHOUGH my opinion on evolution lays no claim to being that of an expert, I feel favourably disposed towards the theory and do not regard it, in any moderate form, as necessarily conflicting with the revealed account of Creation Even if this were otherwise, the

policy of the Southern and Eastern States could never commend itself to those who have learnt lessons from the past Indeed, one might well defend Urban VIII *in re* Galileo—as Huxley did—and condemn Tennessee, Oklahoma and Co in the present issue Of course, the teaching of advanced evolutionism lends itself fairly readily to being made the vehicle for communicating an anti-religious bias To endeavour to inoculate uninformed minds with such a prejudice would evidently be taking an unfair advantage Indeed, such conduct is opposed to science as well as to morality It is out of place, therefore, even with mature pupils, both science and religion should confine themselves to their respective provinces

If any one wishes to combat any doctrine which he regards as erroneous, he should equip himself for the task from the armoury of sound knowledge It is not for the legislature to enter the lists Nor should the State run the risk of even appearing to repress honest inquiry

Prof G H F Nuttall, Sc D, M D, F R S,
Quick Professor of Biology in the University of Cambridge

The leaders of thought throughout the world have for centuries been unhesitating supporters of the principle that intellectual freedom should prevail in university teaching Therefore, the opposition to the principle which we are witnessing in the United States to-day, in the form of legislation against the teaching of evolution, is of a character which must fill us with apprehension for the future of "the land of the free and the home of the brave," and of the ability of that land to continue thus to describe itself Involuntarily we ask ourselves, "What next? Where will this end? if the ignorant majority can thus impede human progress towards truth" The resolution adopted by the Council of the American Association for the Advancement of Science will assuredly be approved by all competent men of science

Sir Oliver Lodge, D Sc, F R S,
Formerly Principal of the University of Birmingham

The outcry against the teaching of evolution in some of the United States seems so preposterous in Great Britain that the only use we can make of it is to bethink ourselves whether we are not doing, or wishing to do, or have not done, something of the same sort in connexion with a less established region of scientific inquiry Actual prohibition may be difficult of accomplishment, but a refined system of boycotting, such as has begun in the United States in connexion with the doctrine and facts of evolution, can be applied with greater ease, and has already been effective in restraining recruits and silencing the utterances of some who might otherwise have been willing to testify to what they know of truth in other subjects Had Sir William Crookes been a university professor it would have gone still harder with him than it did *Lehrfreiheit* is only granted with limitations, it is tolerated so long as it does not outrage preconceived opinion and introduce discord into a pre-established harmony

Rev S M Berry, D D,
Secretary, Congregational Union of England and Wales

All those who have enjoyed an education steeped in the spirit of freedom will hope that the threat to that freedom in the schools of the United States may be averted The idea that teachers should be prohibited from teaching the doctrine of evolution because it is opposed to a certain interpretation of the Biblical account of the Creation, seems to progressive minds on this side of the Atlantic both ludicrous and preposterous To the minds of all progressive churchmen, any such prohibition would be regarded as a set-back to religious progress and a denial of that liberty of opinion in matters of religion which it has taken centuries to win That such a threat should come from the United States is history's latest irony

Rev H B Workman, D Litt, D D,
Senator of London University, Principal of Westminster Training College

Any attempt to interfere with freedom in the teaching of evolution is wholly reactionary, and is bound in the long run to be prejudicial to religion Dogmatism, whether by scientists or theologians, should give place to a greater consciousness of the vast regions of the unknown

Truth and Doctrine in Science and Religion

The vagaries of those near to us in kin are proverbially harder to understand than those of strangers, and it is equally true that it is less easy to appreciate the shibboleths of the generations immediately preceding our own than those of a remoter date It is undoubtedly a fact that the common element in British culture and that of the United States has often served to obscure certain fundamental differences of which the occasional manifestation sometimes amazes and more often bewilders us The tendency shown by certain State legislatures in America in their attitude towards the doctrine of evolution, which has culminated in the prosecution of a teacher in the State of Tennessee for the use of a text-book in which a reference to that doctrine was included, is indicative of a public opinion of a force and character which it is difficult for us in Great Britain and in these days to appreciate

Scientific workers on this side of the water are accustomed to meet their American colleagues on an equal footing They expect to find among them a readiness equal to their own to accept the facts which scientific investigation may bring to light and an equal openness of mind in the discussion of the bearing of such facts upon accepted theory It has, therefore, come with something of a shock to them to find that a movement upon which they may have looked with some feeling of amusement, and as such may not have regarded more seriously than as a passing phase, is likely to prove an obstinate barrier to intellectual progress and freedom of discussion Those who have followed the trend of thought among the intellectual section of the general public in the United States for any length of time may not be equally surprised They have been aware that sooner or later some such question as this was bound to arise It is not so long ago that a well-known American novelist put before his

public, as a living question of to-day, in the church of an American city, the problems which exercised the readers of "Robert Elsmere" when first that book was published in Great Britain nearly forty years ago

The problem with which the more advanced section of intellectual America is now confronted is as old as the hills, or at any rate as old as man himself Every age and every country produces its Socrates and its Galileo Everywhere the prophets are stoned when speculation or scientific discovery comes into conflict with the emotions of the majority

In Great Britain, it is perhaps safe to say that the cause of intellectual freedom has been won It is not likely that we shall witness again a struggle over a purely scientific doctrine, such as that which raged around the controversies of the middle and latter half of last century It is difficult for a generation brought up in the freer atmosphere which is a result of those fierce encounters, to enter fully into the intensity of feeling which was aroused by the theological disputes of the earlier Victorian era The famous Gorham case and the heated discussion of questions of church government which it aroused, and the Tractarian movement, were only a prelude to the storm raised by the publication of F D Maurice's "Theological Essays" in 1854, repudiating the doctrine of eternal punishment, which forced his resignation of his professorial chair at King's College, London, while the heated arguments over the archæological discoveries of Boucher de Perthes in the Somme Valley, which relegated man to a vast antiquity, merely paved the way for the tempest which followed the application of the Darwinian hypothesis to the problem of man's origin

The recent celebrations of the centenary of Thomas Henry Huxley have served to recall the many controversial questions in the discussion of which he was a protagonist, of these, perhaps his encounters with Wilberforce at Oxford, and with Gladstone, have remained most firmly fixed in public memory To his fearless championship of the doctrine of evolution in the stormy years of the 'sixties of last century, following on the publication of "The Origin of Species," is due as much as to any the victory of freedom for scientific inquiry into, and speculation on, the great problems of the origin and development of the forms of life His conception of the sanctity of truth, and his fearless acceptance of facts whatever might be their bearing upon dogma in any field of inquiry, remain the creed of the scientific investigator of to-day But that it is generally recognised as right to hold that creed is due to those who bore the heat and burden of that day—Darwin, Huxley, Tyndall and others of their time Much must be attributed to the force of personality of those who participated in these controversies, and perhaps as much to the writings of one who took no active part in them himself, namely, Herbert Spencer Spencer's writings, and particularly his sociological writings, by their application of the biological conception and the evolutionary point of view to the study of man as a social being, did much to secure acceptance for the doctrine of evolution among the intellectual public

Further, in anthropology the work of Tylor in the comparative study of the beliefs of man demonstrated that behind the great religions of the world there lay a long process of growth which could be traced back stage by stage to the primitive animism of the savage, a work which has been extended and confirmed by the labours of Sir James Frazer At the same time, the studies of the archæologists, in conjunction with the geologists, were extending to more and more remote periods of time, and to an increasingly primitive stage, the evidence for man's existence, in the shape of the primitive stone implements which marked his early efforts to control and shape his environment to his needs Concurrently, the critical study of the Bible—the Higher Criticism—was demonstrating the composite character of its parts, while its sources—notably the story of the Creation deciphered by Smith from the cuneiform inscriptions—were being derived from other than Jewish sources

It would scarcely be worth while to recapitulate these familiar facts if it were not to recall that, immediately following upon the formulation of Darwin's theories and their discussion, there was a convergence of evidence bearing upon the origin and history of man and on his beliefs, some of it derived from an extended application of the evolutionary method of study, which by superseding the traditional static view, tended to facilitate if not the acceptance at any rate the preservation of an open mind towards the central problem

To the scientific mind, perhaps it is a temptation to over-estimate the extent to which the cogency of an argument has appealed to the general public The freedom in discussion of matters of the intellect which has been won in Great Britain must perhaps in part be attributed to the national temperament The key may perhaps be found in the writings of Herbert Spencer, the apostle of the individualism which is the most marked characteristic of the Englishman The appeal to authority which is the negation of the intellectual freedom postulated by scientific inquiry is by tradition and training alien to the British temperament The nineteenth century in Great Britain was a time of intellectual ferment in the political as well as the scientific world, but in both cases it was the culmination of a movement which had been in being for centuries The demand for "Civil and Religious Liberty," which was the war-cry of one of the great political parties of the day, was merely the traditional spirit which gave rise to the Reformation, to nonconformity and to the reforms of the Philosophical Radicals at the beginning of the nineteenth century

It may be that it was by good fortune that the battle of the Darwinian hypothesis and its extension to the evolutionary theory was fought on favourable ground That for us of to-day is a matter of history But it lays upon those who hold the torch to hand it on undimmed and to watch jealously that, in changing conditions, no change can affect the unity of free and unfettered discussion in all matters that appertain to the pursuit of knowledge In these days, when science is universal and co-operation in scientific research transcends national boundaries, it is impossible that what affects a part should not affect the whole The whole scientific world will therefore watch with no little interest and anxiety the result of a trial which may by its results affect the intellectual progress of one of the great nations of the world Not only may it stunt the intellectual growth of generations it may also debar her from all participation in the advancement of one of the most important of the branches of knowledge

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Biology and the Fur Trade

DURING the last quarter of a century there has been an enormous increase in the demand for furs In the United States alone, according to Mr David C Mills, the general director of the National Association of the Fur Industry, " the annual catch of fur bearers in the United States was roughly estimated at about twenty-five millions of dollars twenty-five years ago We estimate it roughly at sixty millions to-day, with quantities fairly well maintained, on the whole, because of the impetus given to trapping by the higher returns to the trapper " But this impetus means more intensive slaughter How great the slaughter is may be gathered from the lists of skins exposed for sale at the fur auctions during the winter of 1925 The total number of skins (excluding Chinese and Australian) greatly exceeded four and a half millions, and a few of the larger items included skunk 652,293, American opossum 456,195, musquash 787,195, squirrel 837,097, mole 357,599

Such destruction of fur-bearers could have but one result, it has involved the usurpation of the annual increase of the animals, and beyond that a trenching upon the capital stock itself to a serious degree That the destruction has already gone too far in many areas is admitted on all hands The officials in charge of the Fur Resources Division of the U S Bureau of the Biological Survey, from a detached point of view, state (September 1924) that " the fur trader of the past was interested chiefly in the quantity of pelts he could collect and when the dressing of furs became well established as an industry in the United States, the fur trade began to appreciate the fact that some of the more valuable fur animals had almost disappeared from our forests and streams, and that the production of a large part of the most important fine furs was confined to the Canadian Provinces While the musk rat, the skunk, and, in places, a few other species are left in considerable numbers, the remnants of this once rich heritage in this country are fast dwindling under present-day conditions " The director of the fur industry association, viewing the matter from a business point of view, is equally emphatic (April 1925) " certain species in some districts have been thoroughly trapped out or at least reduced to a point at which they are commercially unimportant Broadly speaking, the future of the commercial supply of some of the fur-bearing species in all districts is problematical "

Efforts have been made to check the excessive destruction by means of legislation, but legislation labours under special difficulties in these North American territories Each State frames its own State laws, with the result that there is often a lack of

co-ordination in adjacent regions, expressed in differences in the species of animals protected, in varying methods of protection, and, even when method and species agree, in serious variations in the period covered by the close season, when the protected creature is supposed to be safe from interference

It is here that biology has a lesson to teach Knowledge of the life-histories of fur animals and of the biological zones where conditions of livelihood are more or less uniform, should be able to bring order out of the chaos of legislation It is to biology that both the fur-traders and the officials interested in animal resources look for rescue from the slough into which the fur industry is sinking of its own weight It is impossible, and only a narrow outlook could regard it as desirable, to put a stop to those interferences with natural breeding grounds—the felling of woods, the draining of marshes, the tilling of the prairie—which are the accompaniments of agricultural progress and of the march of civilisation The most that biology can do is to suggest how the stock of fur animals can best be conserved, and at the same time yield a full harvest, in these areas where food, shelter, and suitable haunts still exist

In the first place it is found that trapping of animals is often carried on after the breeding season has set in This obviously is biologically unsound, for the death of a breeding animal means the loss not only of an individual, but of a prospective adult progeny Furthermore, it is uneconomic, since the breeding season marks a period when the pelt deteriorates in quality, to the loss of the trapper and the trader Everywhere the onset of breeding time should mark the commencement of the "close season," and the open season should not commence until the breeding season has ended

Here another biological consideration comes into force, further to curtail the open season At the close of the breeding period the pelts are in poor condition, and the fact that many poor pelts reach the market is a clear indication that in places the trapping season is too long The casting of the old fur and its replacement by a fresh coat is a routine process influenced by specific idiosyncrasy and by climate, but for most animals the time for prime pelt is limited to a comparatively short period in the autumn Let this, then, be the trapping season, and the markets would gain by a raising of the standard of quality, and the trapper would be better repaid for his labours during a shorter but more intense trapping season

Lastly, variations in State-to-State laws should be regulated, first by the amount of the stock, upon the annual increase of which the trapper may safely trench without endangering the capital, and, secondly, by the climatic factors which regulate the routine of the life-history Broadly speaking, a maximum open season would exist uniformly among adjacent States ranged along a climatic, or more strictly a climato-biological, zone, the uniformity being broken here and there by shorter close seasons where the natural stock was at a low ebb

Such are the biological considerations which the officials of the United States Department of Agriculture are endeavouring to work into the legislation of the States It is matter for thought that while other countries are approaching this high pitch of perfection in the protection of their native animals, Britain has not yet taken even a first legislative step to protect the waning remnant of its land mammals

JAMES RITCHIE

The Chemistry of the Sugars

(1) *The simple Carbohydrates and the Glucosides* By Dr E Frankland Armstrong (Monographs on Biochemistry) Fourth edition Pp xi+293 (London Longmans, Green and Co , 1924) 16*s* net

(2) *Zuckerchemie* Von Prof Dr Hans Pringsheim Unter Mitwirkung von Dr Jesaia Leibowitz Pp xii+322 (Leipzig Akademische Verlagsgesellschaft m b H , 1925) 18 gold marks

THERE is at the present time no up-to-date treatise on carbohydrate chemistry The last edition of Tollens's "Kurzes Handbuch" was published in 1914, the third edition of von Lippmann's "Chemie der Zuckerarten," in two volumes, appeared in 1904, and Maquenne's "Les Sucres" in 1900 Neither of the books before us can claim to be a treatise on the subject, yet they both form useful additions to the literature

(1) Armstrong's monograph has gone through four editions in fourteen years, a fact which is in itself a testimonial Besides having been thoroughly revised and the subject matter to a great extent rearranged, the present edition has been enlarged by the addition to the text of some fifty pages, including two new chapters The author acknowledges his indebtedness to Principal (now Sir James) Irvine and to Dr T P Hilditch for giving him many valuable suggestions, as well as to Mr Rex Furness for assistance in the compilation of the enlarged bibliography

The opening chapter on glucose outlines the general character of this typical sugar and its derivatives, whilst other chapters are devoted to the chemical properties of the hexoses and pentoses as a class and to the carbohydrate alcohols Stereoisomerism is most ably dealt with, and here the author refers to his own work and to that of Lowry and of Hudson The di-saccharides, tri-saccharides, and the one known tetra-

saccharide, stachyose, are also discussed The chapter entitled " Configuration and Biological Behaviour " is concerned with fermentation, oxidation, selective hydrolysis by enzymes, and the behaviour of sugars in the blood

The two new chapters deal with hydrolysis and synthesis and with the polysaccharides respectively In the former the simple law of mass action, illustrated by the rate of hydrolysis of sucrose, is described The synthesis of sugars *in vitro* and *in vivo* is discussed Bourquelot's work on synthesis by enzymes is referred to as proving that when this takes place a balanced reaction is concerned It is pointed out, however, that the work of the author in 1901, and of Hudson in 1914, proves that the system invertase, fructose, glucose produces no sucrose It will be remembered that Brown and Morris, working with the leaves of Tropæolum, found that the first sugar which could be identified as a result of the assimilatory processes is sucrose Parkin made a similar observation in the case of the leaves of the snowdrop, and Davis Daish and Sawyer in that of mangold leaves The first actual sugar to be synthesised is probably a reducing sugar, but the storage carbohydrates are of the nature of sucrose, starch, and the like Whether sucrose will ever be synthesised *in vitro* must remain an open question, its formation in the plant would seem, however, to be associated with vital processes

The chapter on the polysaccharides is useful, but it has not been possible to give more than a bare outline of the subject Pectins and gums are not mentioned

The chapters on the natural and synthetic glucosides, and on the function of carbohydrates and glucosides in plants, will be read with great interest, containing as they do so many valuable suggestions Under respiration in plants, a concise account is given of Palladin's theory of respiratory chromogens, whilst Wheldale's work on antho-cyanins is alluded to In connexion with the tannins, the observations of Kraus and of Busgen that they are structural materials, as instanced by their disappearance from young cork cells, are mentioned, but there is no reference to the work of Drabble and Nierenstein that condensation products giving reactions similar to those of cork are formed by treating a mixture of formaldehyde and phenol or tannin with an acid This is important as giving a clue to the formation of cork from tannins

Whilst as a whole the monograph deserves the highest praise, we venture to think that the subject matter might have been better arranged There is over-lapping, and even repetition, between some of the chapters This, however, can only be remedied by rewriting and recasting the book, it is unavoidable when an edition has only been revised and extended The diction is clear and there are no serious typographical errors We notice one contradiction in terms on p 47 "In anhydrous alcohol (which, however, contains traces of water) " This is a mere slip, and it is quite clear what the author means One important feature of the monograph is that it is written in an unbiassed manner The author states his own views as well as those of other chemists who differ from him on any point We cordially recommend the monograph to all students of the subject with which it deals

(2) Prof Pringsheim's book is intended by him as a text-book for beginners in sugar chemistry It differs entirely in its lay-out from Dr Armstrong's monograph, being more in the nature of sketchy outlines on the subject, in which bare facts are stated devoid of full explanation or of suggestion It is written almost exclusively from the point of view of the organic chemist, the biochemistry of the subject taking only a subsidiary position Structural formulæ are reproduced freely, but little detail is given of the experimental data on which they are based It is only just, however, to add that original references are cited in all cases The author has condensed his subject matter with great skill, but we venture to think that the text has been reduced to too small a compass, for, in addition to the meagre nature of the arguments justifying the theoretical deductions set forth, there are numerous omissions Obviously, therefore, such a book can scarcely be recommended, without qualification, as a text-book for beginners, who at the present time are too often trained merely to memorise formulæ rather than to study chemistry logically as a branch of experimental science

The text is divided into twelve sections under the headings general properties and constitution, oxidation, reduction, condensations, configuration, anhydrous and reducing sugars, amino sugars, synthesis and degradation of the monosaccharides, biochemical reactions of the sugars, the glucosides and their synthesis, disaccharides, occurrence, preparation, and special properties of the most important sugars A useful feature of the work is the inclusion at the end of each section of tables giving the melting point, rotatory power, and principal derivatives of the compounds dealt with, as well as references to the literature References to the literature are also given throughout the text as footnotes

Such criticism as we have ventured to make demands some justification, and to supply this we propose citing some points from the text Just over two pages are devoted to the pentoses, of which arabinose, xylose, and ribose are briefly described lyxose is once mentioned

Of the hexaketoses, fructose and sorbose only are described. It is stated that, according to Hudson's rule, the difference of the specific rotatory powers of the α- and β-aldoses is approximately a constant; this should refer to the difference of the molecular rotations. It is incorrect that starch can be converted quantitatively into maltose by malt diastase, even in the presence of the so-called amylase complement, as the recent work of Ling and Nanji has shown. Nothing is said of Baker's method of preparing maltose by the action of translocation diastase on starch. There is no reference to the cyclic sugars. The obsolete method of Soxhlet of titrating sugars with Fehling's solution in a porcelain dish is described. Following this, however, is a description of Bertrand's permanganate method. Willstatter and Schudel's iodometric method of estimating reducing sugars is described, but there is no mention of the more recent, improved method of Baker and Hulton. Croft Hill's observation that under the influence of yeast maltase (not maltose, *sic*) glucose yields revertose is referred to, but β-glucosido-maltose and isomaltose, which Ling and Nanji have shown to be constant products of the hydrolysis of amylopectin, are not mentioned.

There can be no doubt that, so far as it goes, Prof. Pringsheim's book will be found useful to the student under the guidance of a competent teacher.

Arthur R. Ling.

Physiological Optics

Helmholtz's Treatise on Physiological Optics. Translated from the third German edition. Edited by Prof. James P. C. Southall. Vol. 2: *The Sensations of Vision.* Pp. ix+480. (Ithaca, N.Y.: Prof. F. K. Richtmyer, Secretary, Optical Society of America; London: The Hatton Press, Ltd., 1924.) 30s.

"In developing the consequences of any valid general principle in individual cases, one constantly comes on new and quite unexpected surprises. And as the consequences are not arbitrary, nor contingent on the caprice of the author, I have often the impression that it is not my own work that I am writing out, but some one else's."

Hermann v. Helmholtz.

The text of this volume occupies 468 pages, of which nearly one-quarter takes account of new matter extending beyond the original first-edition treatment; and, of that quarter, fully one-ninth part is specially contributed to the American edition. The contributions of the late Prof. Nagel are a note on the stimulation of the organ of vision by Rontgen and Becquerel rays; another on visual acuity; a section on changes of the retina due to light; a note on complementary colours; one on flicker scotoma; and a large appendix on adaptation, twilight vision, and the duplicity theory. The contributions of v. Kries are a note on contrast, and a long appendix dealing with normal and anomalous colour systems, and with theories of vision. Dr. Christine Ladd-Franklin contributes a new appendix on the nature of the colour sensations.

In his preface to the German edition, Nagel gives his views on the relations of the new work to the older work, as utilised by Helmholtz, in the following words:

"In that region of the 'Sensations of Vision' the main question to be decided first of all was whether Helmholtz's conception of the structure and action of the mechanism of colour perception could still be considered as an adequate explanation of all the new observations that have been made in the last four decades; and if not, whether these ideas should be discarded altogether, or, finally, whether it would be really profitable to introduce here additional supplementary hypotheses. The editor's position on this question is that there is no reason whatever to abandon the fundamental ideas of the colour theory which Helmholtz espoused; although the assumption of the organisation of the mechanism of colour perception in three components is no longer sufficient to give an entirely satisfactory account of all the known facts of colour vision."

Helmholtz so clearly recognised the differences of the rod and cone structures and functionings that, in the first edition of his work, he showed with elaboration (pp. 30, 31, ii., Amer. edn.) that the rods could not act in the same way as the cones, and he considered them to be visually ineffective. The cones he regarded as "the elements that are *peculiarly* sensitive" (italics are ours). Subsequent gain of knowledge gave rise, in the second edition, to the statement that:

"From the perfectly analogous anatomical structure of the rods it is extremely probable that they also must have the same sort of capacity; which was the opinion of H. Muller and Koelliker. Nevertheless they must play an entirely different rôle in the localisation of sensations, because, in spite of their being finer and more numerous in the peripheral parts of the retina where they predominate, the power of discrimination between very similar impressions is more imperfect in this region than it is in the fovea."

Since it was known to Helmholtz (second edition) that rod vision is colourless, these statements, if they be not regarded as an actual initiation of those developments of view which have become known as the Duplicity Theory, most certainly pave the way for it. The reticence of his assertions is an example of the characteristic caution and single-eyed aim at the expression of truth which led him to avoid all statements not based on recognised fact. On the whole, from probabilities regarding development of the organ of sight, and also in view of the more recent

investigations, it seems to be most likely that rods and cones are examples of specialisation along a common line, arrest of development towards colour discrimination occurring early in the case of the rods So that Helmholtz's general scheme of colour vision, including colourless vision as a special case of course, applies throughout the whole range of normal and abnormal vision

The distinguished developer of the Duplicity Theory, v Kries, says that "Even at the present time the theory of Helmholtz is thoroughly justified as to its fundamental conceptions," and he corrects "some misunderstandings under which the theory has laboured in many ways" "Fundamentally, the Helmholtz theory was simply the expression of a direct fact of observation, namely, that *the resultant of all the various light stimuli so far as sensations are concerned can be completely represented as a function of three variables* It is idle to try to explain this fact except on the assumption that the *result of the stimulation* also can be represented completely as a function of three variables" The point may be put even more strongly, for it is the component and resultant *sensations* that are estimated The equation

$$cC = rR + gG + bB$$

asserts as a fact that the general sensation of type C can be produced by compounding three sensations of independent fixed types R, G, B It is the psychological trichromasy of all sensations that is asserted In regard to dichromatic vision, v Kries says that "the researches have completely verified Helmholtz's conjecture of two main types each due to abstraction of one component fundamental sensation," but he finds difficulty with regard to anomalous trichromasy The reason is that he overlooks Helmholtz's own use of intertransference, partial or complete, of actions which normally affect one fundamental sensation alone This is given with other matters in seventy-two precious pages of the second edition, the absence of which from the third is an unfortunate consequence of the adoption of the text of the first edition Some extracts from the second edition are given It is regrettable that these pages were not included as an appendix, for they contain the development, by Helmholtz himself, of the trichromatic theory to its highest consummation, in making which he must have had "the impression that it is not my own work that I am writing out, but some one else's"

Dr Christine Ladd-Franklin gives an account of her views on colour vision, in which she postulates five physiological activities corresponding to red, yellow, green, blue and white All phenomena of vision can be expressed in terms of five or more activities, but the law of trichromasy, being a psychological law, asserts that only three are independent The two conditions, $R+G=Y$ and $R+G+B=W$, which she gives, specify the two interconnexions requisite to limit the independence to the observed amount The outstanding interest of her suggestions lies in the exhibition of a mechanism, which may prove to be the actual one, which satisfies the conditions for restriction of independence, and accounts readily (as also does the developmental view of Helmholtz's trichromatic scheme) for a fused yellow sensation

The strictures made in the appendices on Hering's scheme are really unmerited Any condition explainable on the trichromatic scheme can be explained by his with appropriate specifications

This volume, because of the wealth and importance of the new matter, should be regarded as indispensable by every student of, or worker in, the subject of visual sensation W PEDDIE

More Torchbearers of Science

The Torch-Bearers By Alfred Noyes Vol 2 *The Book of Earth* Pp vii+375 (Edinburgh and London Wm Blackwood and Sons, 1925) 7*s* 6*d* net

MR NOYES has followed up his first volume of "Torch-bearers," which was reviewed in these columns on May 20, 1922, by a second and rather larger book, volume ii, with the sub-title of "The Book of Earth" It will be remembered that the first volume was inspired by a night spent in the Sierra Madre Mountains when the first trial was made of the new 100-inch telescope, and it treated of the growth of astronomy from Copernicus to Herschel It was a notable attempt to carry out the destiny predicted for poetry both by Wordsworth and Matthew Arnold in Great Britain, to express the truths of science in the sort of language which had always served mankind as the vehicle of the highest and eternal ideas We hailed it as such and are glad to think that the three years since its publication have deepened the public appreciation of Mr Noyes' effort The second volume will not be found to belie these expectations It deals with a much more difficult subject from the point of view of poetic presentation, namely, biology, or rather geology as a preface to zoology and evolution as crowning geology It leaves one in some doubt as to the scope of the third volume which we are promised in the preface to the first Is the biology to be completed? Heaven, earth and man would seem to be the natural division Yet in this second volume we are brought down to Huxley at the famous Oxford meeting of the British Association so what remains for the third, unless it is to be devoted to relativity and the general

philosophical change in scientific ideas which has taken place in the twentieth century?

It is rather to be hoped that this is not the case, as Mr Noyes' original instinct was correct to seek for, and, if necessary, create, dramatic moments to express the onward march of scientific thought He is least successful in the more abstract parts of his argument, but effective and often moving in his narrative and dialogue

This second volume begins by thoughts suggested by gazing downward into the Grand Canyon, as the first began by looking upward from the Sierra Madre The contrast is apt and the field is well chosen from the New World, where land and waters and all the expanses of space are so much vaster than with us The cantos then proceed chronologically from Pythagoras and Aristotle through the East (Farabi and Avicenna) to Italy with Leonardo da Vinci, France with Jean Guettard, Sweden with Linnæus, and evolution in three cantos, Lamarck and the revolution, Goethe and Darwin

There are good things throughout, but we will select three as typical of Mr Noyes' thought in different aspects The first comes from the second canto, in which the poet imagines a scroll written by Pythagoras and handed by Nicomachus to the young Aristotle as they were walking by the seashore near Stagira The boy lies down at full length on the rocks and spreads out the papyrus which bids him

> "Guard the immortal fire,
> Honour the glorious line of the great dead
> To the new height let all thy soul aspire,
> But let those memories be thy wine and bread"

A noble song, sustained through seven verses, and giving the keynote of Mr Noyes' thought in these volumes, the triumph of new truth found by following the footprints of great thinkers in the past

Our second extract is from the fourth canto—The Torch in Italy The subject is a conversation between Giulio, the pure artist, a believer in the absolute and self-sufficient inspiration of the moment, and Leonardo, who does not disclose his identity until the last word The artist proclaims the independence of the artistic inspiration "All genius is capricious You'll admit that men who lived like beasts have painted well"

> "Yet," replies the stranger,
> "For the greatest Art I have always found
> A certain probity, a certain splendour
> Of inner and outer constancy to law"

This is the note which Mr Noyes has recently developed, so far as poetry is concerned, in his essays in criticism it is also of the highest moment for his theme in this book, the essential connexion between the right direction of the mind in both science and art Each aspect is creative of new truth, and neither can attain its fullest realisation without elements belonging more intimately to the other

The part of the book which will attract the most attention is Canto IX, called "Darwin" This contains the most vivid and moving account ever written of the debate at the Oxford meeting of the British Association in 1860 It is evidently based on the reports of eyewitnesses and is an admirable piece of poetic narrative The tense excitement of a crowded audience, largely clerics, the determination of Wilberforce to crush Darwin once for all, the postponement of the debate, the ticking of the clock until the moment arrives when Huxley muttered low—"The Lord hath delivered him into my hands" The portraits of all the leading speakers, Henslow, Draper, Owen, as well as the two protagonists, are as good as possible Then the book winds up with the reaction in Huxley's own mind that night after the triumph of the day Had not his victory "a relish of the dust"? Had he not used more skilfully the unworthy weapons of his foe? Was there not yet a far larger truth than Darwin had proclaimed and he had so successfully defended? And so on to the Epilogue on "The Eternal Mind which enfolds all changes and can never change"

A remarkable and inspiring book

F S MARVIN

A Quantitative Study of Regeneration in Plants

Regeneration from a Physico-Chemical Viewpoint By Jacques Loeb (McGraw-Hill Agricultural and Biological Publications) Pp x+143 (New York and London McGraw-Hill Book Co, Inc, 1924) 10*s* net

In view of the sudden loss of Jacques Loeb from the ranks of scientific workers, it is particularly valuable to have in the form of this monograph his own presentation of his views upon regeneration, based upon the long series of experiments he carried out upon Bryophyllum in recent years, recorded so far only in a number of papers in the *Journal of General Physiology*

In the preface, Loeb states that it is "not more facts which are needed in this field but a method and a principle which allow us to pass from the stage of blind empiricism to the stage of an oriented research" This method Loeb thinks he has found in the study of the quantities of the regenerated tissue by dry weight determinations, the principle he suggests is the simple mass relation thus indicated as determining the amount of regenerated tissue, namely, that it is proportional to the mass of original tissue allowed to regenerate His point of view brings him sharply into conflict with many views in great favour at the present day, and is

perhaps none the less valuable for that He rejects entirely the suggestion that wound hormones stimulate new growth, a view much in favour on the Continent under the influence of Haberlandt, and concludes as the result of quantitative studies that the mutilation favours regeneration, because it isolates within a limited mass of tissue, as a severed leaf, a local store of food material which is thus available for regeneration On the undamaged plant this store would be withdrawn and used for normal growth elsewhere

The same quantitative attack leads Loeb to another interpretation than that now frequently prevalent, as to the inhibiting action of one growing tissue upon another Starting from a simple quantitative analysis of the fact that a leaf alone regenerates more freely than a leaf still attached to a piece of stem, he reaches the conclusion that the food supply used for regeneration in the isolated leaf is shared between leaf and stem in the second case, and largely exhausted in growth processes within the stem, including callus formation He is thus led to reject a view first adopted by him, as is clear from his original papers in the *Journal of General Physiology*, which still seems to emerge in his phraseology when he speaks (in Chapter xii) of the inhibiting action of the "descending sap from the leaf" upon shoot formation on lower regions of the stem This inhibiting action he now traces to the fact that the food supply from the leaf is wholly used up in growth processes within the young stem, just as the inhibiting action of an actively regenerating shoot or root upon other shoots or roots later in starting, is put down to the utilisation by the earliest growth centres of all the reserves available for growth He thus discards the view that the "descending sap" inhibits in virtue of its content in growth-inhibiting hormones (now sometimes termed "chalones")

Loeb's point of view was very physiological, and apparently he never felt the need to work out his conceptions upon a basis of anatomical detail He was satisfied to interpret his interesting experiments upon the influence of gravity upon regeneration, as showing the movement through the tissues of the plant of soluble substances necessary for growth, so that they collected in the lowest regions and favoured growth there On experimental grounds he concluded this movement was distinct from the movement of sap in the vessels of the plant, but he never considers further the path by which this nutrient sap moves under the influence of gravity Again, his experiments upon polarity lead him to the conclusion that the *anlage* of the regenerated shoots and roots must lie in different regions of the plant, but he makes no reference, for example, to the detailed anatomical investigation of cases of regeneration from leaves, in which it has been shown that shoots may originate from epidermal cells whilst roots always arise from cells in the neighbourhood of the vascular cambium

Loeb's experiments may be in many respects open to criticism, one criticism already made has been that Bryophyllum plants do not always behave like Loeb's plants But there can be little doubt that Loeb has placed on record a series of valid quantitative data which do supply some guidance as to the phenomena involved in regeneration, and though their complete interpretation will require much further work, involving correlated studies in anatomy, cytology, etc , Loeb has once again blazed a pioneer trail in his steadfast insistence upon quantitative work in a field which is almost obscured with descriptive qualitative details

Relativity and the Metaphysician

The Tyranny of Time Einstein or Bergson? By Charles Nordmann Translated from the French by E E Fournier d'Albe Pp 217 (London T Fisher Unwin, Ltd , 1925) 10*s* 6*d* net

ALL our life we have looked with awe on metaphysics, its problems are so abstruse and the meaning of the metaphysician's solutions so difficult to understand Occasionally a doubt arises in our mind whether metaphysics is empty words with no reality behind But we always suppress the doubt For how could a subject be mere empty words which has held such an exalted and honourable position through all the ages from the brilliant era of the Greeks down to our own times

Then comes Einstein's doctrine of relativity The aim of the metaphysician is to take the laws of Nature, including those provided by mathematicians and physicists, and fuse them into an intelligible whole It is, therefore, incumbent on him to understand Einstein's doctrine Even if he rejects it, he must first understand in order to be in a position to reject it A study of the treatment of relativity by different metaphysicians brings us a little nearer to the answer to our question whether they deal with words or with realities

The first group treat the subject with all the understanding of the mathematician It is, in consequence, open to us to believe that those portions of their work that are beyond our understanding are equally sound, and our respect for them continues

Another group find all the knowledge of the doctrine that they need in the word "relativity" The name reminds them of Bishop Berkeley, who believed in the relativity of the external world in the sense that that world existed only if there was a conscious mind present to perceive its existence This group is content to identify Einstein's doctrine with Berkeley's

A third group have studied Einstein's doctrine and

have failed to understand it, and, at the same time, are unconscious of their failure The author of the book named above belongs to this group The object of the book is to decide between Einstein who teaches that the simultaneity of two events is relative, and Bergson who holds Einstein to be wrong and simultaneity to be absolute The author's conclusion is that both of them, as well as every other writer he mentions, are wrong, sometimes if not always He tells us that Einstein's original exposition, published in 1905, is perfectly correct, but that he is a bad populariser and that his little book, "Uber die spezielle und die allgemeine Relativitatstheorie gemeinverstandlich," is wrong, and that poor Bergson was led astray through reading the popular account only He then proceeds to give what he calls an improved and correct popular account, and throws in (page 185) the modest disclaimer "In making this attempt I do not, of course, wish to put myself above Einstein"

Actually the author is floundering in the bog of his own misconception of Einstein's meaning, one of his mistakes being failure to distinguish when Einstein is engaged in overthrowing the classical theory and when he is stating the theory which is to take its place

The contemplation of the second and third groups of metaphysicians compels us to conclude that in some cases the discussion is of empty words with no underlying reality, and that we shall be wise to exercise discretion in all cases as to the acceptance of the metaphysicians' conclusions

Nor was any other conclusion to be expected Consider the magnitude of the task the metaphysician undertakes His aim is to fuse all knowledge into an intelligible whole To do that he must first make himself acquainted with all knowledge It is true that he needs only general principles and may ignore details, but even so the mass of knowledge at the present day makes it an enormous task Moreover, that is not the worst, for he must keep abreast of developments in all subjects, and developments of importance are taking place to-day in many subjects We can only admire his courage and leave him to it D B M

Folklore in India

The Folklore of Bombay By R E Enthoven Pp 353 (Oxford Clarendon Press, London Oxford University Press, 1924) 14*s* net

MR ENTHOVEN'S book will be welcomed by those who require a very full synopsis of the folklore of the Bombay area He has gathered together a vast mass of items which he has classified under subject headings—such as worship of natural objects, tree- and snake-worship, spirit-possession, totemism and animal-worship, evil-eye, dreams and omens, etc Under each category he cites a large number of beliefs and practices, the material having been partly collected by himself and partly derived from the works of others such as B A Gupte and Sir J Campbell The compilation of this material must have involved much labour and search The value of such a "corpus" of facts is evident, and the volume will prove an important reference-work

The facts are simply stated for the most part, without elaboration, and there is little attempt to diagnose and explain the underlying motives which have dictated the beliefs, rituals, and customs recorded Such interpretation would have added much to the interest and usefulness of the book, but the author may, no doubt have realised the difficulties attending any attempt to probe the "true inwardness" and origin of superstitious beliefs and practices Natural reticence on the part of the natives, coupled, as it usually is, with actual ignorance of the original, and even the present significance of their observances, militates against accurate diagnosis on the part of the researcher, and satisfactory explanations are not easily found Mr Enthoven's long residence in India gave him opportunity for seeing below the surface, and his views upon the *raison d'être* of many of the, seemingly, more inconsequent practices and beliefs which he describes, would have been welcome At the same time, it must be admitted that long residence is liable to instil caution, by revealing difficulties and pitfalls which are hidden to the tenderfoot, and to cause the experienced Western student to realise how ill-equipped he really is to probe and analyse the mentality of Oriental peoples Recognition of obstacles difficult to surmount may have acted rightly as a deterrent, and have induced the author to abandon the open, speculative game and to play for safety

The *comparative* study of superstitions has done much towards suggesting explanations of folk-phenomena, and will surely lead to further results The object of the author of this volume is, however, to deal with the subject from a descriptive and not a comparative point of view The book makes available for the student an extensive, classified collection of *data* concerning in the main a single, if extensive, area, and it has an intrinsic interest, as reflecting the culture-status of the people within that area This collection of facts will be appreciated by the comparative folklorists and ethnologists, who can collate the local material with similar phenomena recorded from other regions, and can study the whole on a broader basis The book would have had added value had the author given in all cases the sources whence the items of information were collected References are, unfortunately, few, and it would have been of interest to

know the extent to which the author's own observations have played a part in supplying material for this interesting volume

A useful appendix has been contributed by the late Dr William Crooke, in the form of a *questionnaire* on folklore This enumerates many of the chief topics upon which information is needed, and should prove of considerable service to those residents who are anxious to increase our knowledge of the peoples among whom they live The field-student should be warned that, in pursuing his investigations, *direct questions* should be avoided at all costs HENRY BALFOUR

Our Bookshelf.

Geschichte der Rube (Beta) als Kulturpflanze von den altesten Zeiten an bis zum Erscheinen von Achard's Hauptwerk (1809) *Festschrift zum 75jahrigen bestande des Vereins der Deutschen Zuckerindustrie* Von Prof Dr Edmund O von Lippmann Pp vi+184 (Berlin Julius Springer, 1925) 12 gold marks

PROF E O VON LIPPMANN, Director of the Zuckerraffinerie, Halle, to whom we are indebted for such a vast quantity of accurate information upon the history of chemistry, has now written a book which will interest not only those engaged in the sugar industry, but also botanists, chemists, and agriculturists It is unnecessary to say that this latest production is characterised by the same sound scholarship and exhaustive research which marked the "Entstehung und Ausbreitung der Alchemie"

The earliest mention of the mangold appears to be in the "Acharnians" of Aristophanes (455–388 B C ?) It is described by Theophrastus in the "Historia plantarum," and was certainly cultivated by the Greeks Among the Romans, again, the plant was well known and is mentioned by Cicero, Catullus, and others Since species of Beta grow wild on the North African shores of the Mediterranean, it is possible that turnips and mangolds may have been known to the ancient Egyptians Whether this is so or not, they were common in Egypt at the time of Alexander the Great (333 B C), and are often mentioned by the Alexandrian alchemists of the third to fifth centuries A D

In later times, turnips, mangolds, and beetroot were all widely cultivated, and Prof Lippmann takes his story up to the beginning of the nineteenth century Although he modestly says of his book, with Luther, *Exemplum vobis dedi ut plura faciatis*, he has obviously searched the available literature with great care

E J H

Coal and Civilisation By Prof Edward Charles Jeffrey Pp xvi+178 (New York The Macmillan Co, 1925) 10*s* 6*d* net

THIS work may be considered as consisting of two parts, namely, a description of coal, its origin and structure on one side, and the application of coal in the service of mankind on the other The former is of great interest and contains much novel matter, as might be expected from so distinguished a botanist as Dr Jeffrey The second theme is, however, very indifferently handled and forms a sad contrast to the former Dr Jeffrey has evidently failed to appreciate the real effect of coal upon the history of civilisation, thus he repeatedly urges that British supremacy in the eighteenth century was due to the application of mineral fuel to the smelting of iron, but entirely overlooks the far greater issue, namely, that almost simultaneously the steam engine was developed in Great Britain, thus for the first time pressing latent energy into the service of mankind, which had up to then been forced to rely upon kinetic energy only The author's technical knowledge of the subject is also not so sound as it might be For example, he states that brown coals are treated "by briquetting with suitable binding media," whereas the chief value of brown coal lies in the fact that it is capable of being briquetted without the use of a binder

In respect of the structure of coal and of the plants that enter into its composition, the views of Dr Jeffrey are important and instructive, it may, however, be suggested that he seems inclined to put too much stress upon the fresh-water origin of coals and to have somewhat neglected the evidence of marine conditions It might have been expected that the Delta theory of Fayol would have received some attention, Dr Jeffrey is a convinced supporter of the view that coal is the product of plant remains transported to the waters in which the organic matter was deposited, but scarcely deals effectually with evidence contradicting that view, such as that afforded by the existence of under-clays with stigmarian rootlets

An Introduction to Psychology By Prof Hugh A Reyburn Pp v + 324 (Cape Town Maskew Miller, Ltd, n d) n p

THIS is an attempt to compress a protean subject into 316 small pages, and, on the whole, a successful one The fact that a well-chosen and comprehensive bibliography of 52 works follows the 16 chapters shows that the author recognises that his "Introduction to Psychology" is an introduction and nothing more, but it is no mere summary of what is already known, being very definite as to points of agreement with, and dissent from, other authorities

The introduction of new terminology, always to be feared when opening a work on psychology, is avoided, and where there would otherwise be the possibility of doubt as to the application of any term, the context renders the meaning intended unmistakable

Prof Reyburn defines his subject as "the science of immediate experience" He does not, however, deal with objective manifestations to the neglect of the subjective, but attaches a good deal of importance to introspection All that is most valuable in modern psychological schools of thought has been utilised or incorporated, but the extremist views of Freud and the behaviourists are not supported A fear is expressed in the preface that the section containing an account of the nervous system may prove too long, but a closer condensation than the succinct summary given would scarcely be possible Indeed, an amplification of the paragraph dealing with the cerebral cortex would be a desirable addition to future editions It is rather remarkable that in a work on psychology containing much clear reasoning and sound judgment, the terms reasoning and judgment are not given even an indical reference

Isis International Review devoted to the History of Science and Civilisation, Official Organ of the History of Science Society No 21, Vol VII (1), 1925 Pp 168 (Soc Anon M Weissenbruch, 49 rue du Poincon, Bruxelles) Annual subscription, 26*s*

ALTHOUGH *Isis* has become the official organ of the recently founded History of Science Society, it is happily still edited by Dr George Sarton, its originator The present number maintains the high standard which has been set by its forerunners, and the width of its appeal may be judged from the fact that it includes contributions from Essen, Rome, Madison, Belgrade, Amherst, and Montpellier

Two articles of special interest are those by Prof A J Hopkins on "A modern theory of alchemy," and Prof Emile Turrière on the history of glass-making in western and central Europe from the Middle Ages to the end of the eighteenth century Prof Hopkins's theme is that the alchemists, far from failing in their quest, were successful, since their conception of "gold" was very different from ours "The reason why we cannot follow the alchemistic theory or look upon those conceptions with sympathy is that the alchemist, like the artist, was stressing the changeable Aristotelian qualities where we stress weight and fixed qualities The alchemist fitted theory to practice and succeeded far beyond the realm of probability According to his definition of 'gold' transmutation *was effected* The alchemist obtained what he wanted" Although this theory of alchemy is not so novel as Prof Hopkins appears to imagine, it has never received proper consideration Yet it obviously explains much that is obscure, and Prof Hopkins is to be congratulated upon having set it forth so clearly and logically

Narcissus an Anatomy of Clothes By Gerald Heard (To-day and To-morrow Series) Pp 156 (London Kegan Paul and Co, Ltd, New York E P Dutton and Co, 1924) 2*s* 6*d* net

THREE mottoes face the table of contents of this book, two from "Sartor Resartus" and one from Michael Angelo The analogies they draw between life and clothes, the body, and architecture and its products, are worked out in detail The author takes the line that psychology having resolved to treat nothing in its province as insignificant, clothing, now regarded as unimportant, may be assumed to be of racial significance, as a phase of the evolution which started on new lines when man emerged Mr Heard regards both clothes and architecture as parallel manifestations of an evolutionary force, tracing them from the beginning of weaving and the use of woven wattle for walls in the neolithic age, through Egypt, Mesopotamia, Crete the classical period and historical times, down to the ferro-concrete building of to-day and modern costume, where development apparently has ceased Fanciful though the analogy may seem, it is perhaps not extravagant to assume that racial character manifesting itself in two media so entirely different may still exhibit a certain convergence in style so far as conditions allow After a certain stage, however, the standardising, more or less, of all modern communities is unlikely to offer much play for racial individuality, however either clothing or architecture may develop

Tales from Nature's Wonderlands By Dr William T Hornaday Pp xii+235+24 plates (New York and London Charles Scribner's Sons, 1924) 12*s* 6*d* net

FORTUNATE indeed are the children who can claim the author of this book as grandfather and exact from him, as a grandchild's privilege, the charming stories here published The author has covered a wide range of subjects, from the origins of the American fauna to life in the deep sea, from the American mammoths to the lung fishes of Australia, from giant monster reptiles of Hell Creek to the penguins of the Antarctic Continent, from the forests and jungles of India and Borneo to the mountain crags of the Canadian Rockies and the ice-bound Polar Seas In all he is equally happy, interesting and vivid, telling his story in simple compelling language well calculated to stir the imagination of children It was a happy thought to publish these stories from Nature's book, so simple and so scientifically accurate, and we would wish, with Dr Hornaday, that all our young people should become acquainted with them The photographic illustrations are good, and materially help towards a proper understanding of the text

Chambers's Encyclopædia a Dictionary of Universal Knowledge New edition Edited by Dr David Patrick and William Geddie Vol 6 Hume to Manche Pp iv+872 (London and Edinburgh W and R Chambers, Ltd, Philadelphia J B Lippincott Co, 1925) 20*s* net

THE latest volume of this convenient encyclopædia maintains the high standard of the work The articles have been revised or re-written, and many new articles have been added References to books published within the last few months are not infrequently included There is a liberal allowance of excellent coloured maps, besides a number of smaller black and white maps, and many illustrations and diagrams The encyclopædia is to be completed in ten volumes

Outlines of a Philosophy of Art By R G Collingwood (The World's Manuals) Pp 104 (London Oxford University Press, 1925) 2*s* 6*d* net

IF this manual has a fault it is not that it is ill-done but that it is done too well The author has instilled into his account of art a complete philosophy of life Perhaps it was impossible to separate the two, but it demands of the reader a more than usual concentration of his attention On the other hand, any one who wants a clear and concise account of Croce's æsthetic doctrine will find it admirably presented in the first chapter

Traité de psychologie Par Prof Georges Dumas Tome 2 Pp 1173 (Paris Felix Alcan, 1924) 60 francs

THIS is M Dumas' second volume of an extensive survey of recent work in psychology Though named a treatise, it is in effect an encyclopædia It is a collaboration of the leading French psychologists, each of whom has been invited to write a dissertation on the special subject matter of his own research It is a valuable work of reference, with a detailed bibliography attached to each section

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE *No notice is taken of anonymous communications*]

Preliminary Note on the Transmutation of Mercury into Gold

THE experiment on the transmutation of mercury was begun in September 1924, with the assistance of Messrs Y Sugiura, T Asada and T Machida The main object was to ascertain if the view which we expressed in NATURE of March 29 1924, can be realised by applying an intense electric field to mercury atoms Another object was to find if the radio-active changes can be accelerated by artificial means From the outset it was clear that a field of

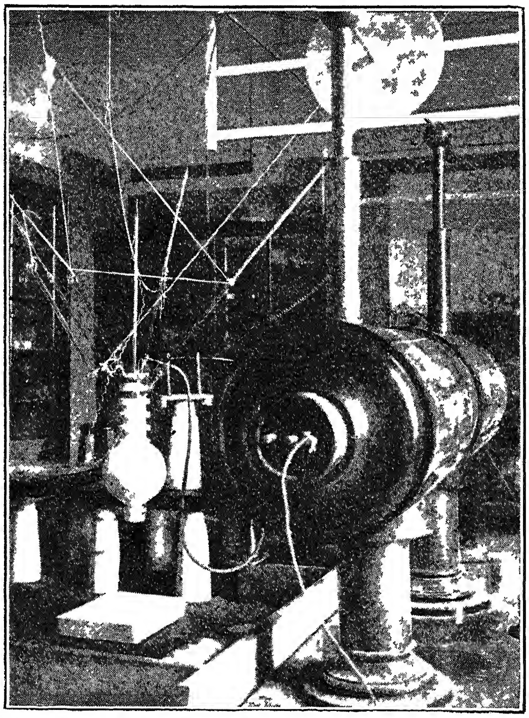

FIG 1 —Apparatus for the electric discharge Discharge vessel is supported on four glass insulators

many million volts/cm is necessary for the purpose From our observation on the Stark effect in arcs of different metals (*Jap Journ Phys*, vol 3 pp 45-73) we found that with silver globules the field in a narrow space very near the metal was nearly 2×10^5 volts/cm with terminal voltage of about 140 The presence of such an intense field indicated the possibility of obtaining the desired strength of the field for transmutation, if sufficient terminal voltage be applied Though the above ratio of magnification would be diminished with high voltage, the experiment was thought worth trying, even if we could not effect the transmutation with the apparatus at hand

Fortunately an induction coil of 120 cm spark length, made by Klingelfuss, was available for the purpose (Fig 1) For keeping the terminal voltage between the electrodes sufficiently great with a short spark gap, the discharge was conducted in paraffin oil, in which a potential difference of about 15×10^4 volts/cm can be maintained With iron and purified mercury as electrodes, the discharge appeared at first as arcs, and the spectrum was continuous, it gave rise to abundant production of gases and carbon particles from the oil, the mercury gradually turned into fine globules, until the oil and mercury were mixed into a black pasty mass We cannot definitely say whether the intense field observed during the experiment on the Stark effect was present during the discharge or not, but it is probable that mercury atoms have been acted upon by strong electric force during the violent bombardment, as the discharge is of an analogous nature Continuing the discharge for about four hours, the product was examined chemically for gold by the test of Cassius'-purple, the result was decidedly positive This experiment was performed on September 15, 1924, on succeeding days experiments were repeated, and two days after, Mr Yasuda, an expert in gold assaying, showed us minute gold specks extracted from the black mass obtained in the experiment of the previous day Grave doubts were, however, expressed by critics as to the purity of the mercury and also as to the possible presence of traces of gold in the chemical laboratory, due to frequent treatment of the metal

To clear away these doubts, the mercury to be used in the experiments was first purified by ordinary chemical means, and then subjected twice or thrice to vacuum distillation, care being taken not to raise the temperature above 200° The mercury, oil and chemical reagents used in the experiments were carefully examined by making blank tests A room in the physical laboratory was allotted to the chemical experiments Succeeding experiments confirmed the result, but the glass vessel was too fragile to pass the heavy condensed discharge, and it exploded during the process Bushing insulators were tried but the tube was too narrow, and the discharge passed into the walls A discharge vessel of about 2 litres capacity with walls of 2 cm thickness, provided with a long neck and a short tail for inserting the electrodes, was designed and made ready for experiment in the beginning of May During these intervals, minor tests were made with the porcelain flask on the mode of discharge, the oil to be used for the process, the material of one of the electrodes, and easy means of detecting the presence of gold

As we found in our investigation on the Stark effect, it is always advisable to insert condensers in the discharge circuit We used bushing condensers of many glass plates with thin lead plates between them, the total capacity being about 0 002 microfarad As the discharge potential is very high, the condenser plates are apt to break, and must be so large that discharge between the end plates does not take place in air

As iron contains many impurities, we found that tungsten wire, free from thorium oxide, which we obtained through the courtesy of the Tokyo Electric Company, is the best on account of the small corrosion during the discharge

As to the method of testing, the formation of ruby glass is delicate and in most cases accompanied by the separation of gold particles at the centre or outside boundary, which can be observed with a metallographic microscope, by using reflected light

A special distilling flask was designed for the purpose of separating carbon, oil, and mercury from the residue in the discharge vessel, after bombarding the mercury for 10 to 15 hours Paraffin, kerosene, and transformer oil can be used, but the last seems to be the most suitable

The gold obtained from mercury seems to be mostly adsorbed to carbon Ruby glass is formed by heating small pieces of glass with the carbon, in the process now used it is formed in numerous spots on the walls of the distilling flask by repeatedly heating it to about 600° We have often separated mercury by washing the oil with benzene and ether, and after separating it from carbon by centrifugal separator, distilled it in vacuum and examined the

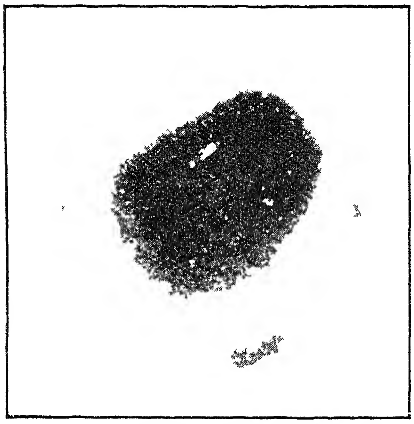

Fig 2—Ruby glass by transmitted light ×150

residue, which generally contained no gold, but a minute quantity of white metal, which may probably be another product of heavy discharge, it was, however, too small to be tested chemically

The accompanying illustration (Fig 2) shows a spot of ruby glass photographed with transmitted light and magnified 150 times The central dark portion contains gold particles distributed as shown in Fig 3 taken with reflected light and magnified

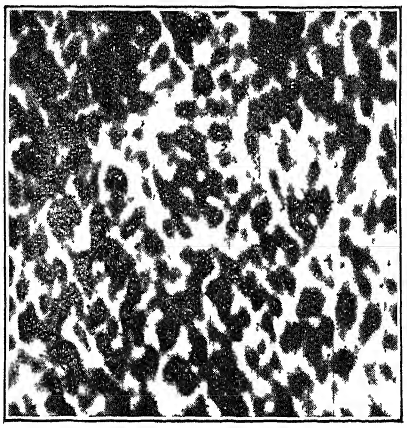

Fig 3—Ruby glass by reflected light ×2500

2500 times It represents only a small part near the boundary of the central spot The white ring is greenish blue, and the lightly shaded one is rosy, these colours are characteristic of gold colloids Numerous spots of this kind are obtained in the bottom of the distilling flask during the after-treatment of a mixed mass of carbon and mercury after heavy condensed discharges Sometimes ruby glass is apparently covered with a thin film of gold, on microscopic examination it is found to consist of fine particles of gold very densely distributed The primary current in the induction coil in such experiments ranges from 25 to 30 amp, and the spark length in air is more than 1 m

Probably we could produce the same effect by using lower voltage, if sufficient capacity were inserted, but the resistance of the vessel is not great enough to withstand the heavy discharge, especially when carbon and mercury are intimately mixed together The construction of a proper discharge vessel seems at present to be a difficulty in getting an amount of gold sufficient to determine its atomic weight Which of the isotopes of mercury is changed into gold can perhaps be inferred from the atomic weight Spectroscopic examination will be started so soon as we can obtain sufficient material for the purpose

The process taking place may be looked upon as due to commotion in the nucleus by intense electric force If we assume that Coulomb's law ceases to hold within the nuclear boundary, the positively charged protons form a compact core and the electrons within the boundary surround it On applying an external electric field the motion of the core is opposite to that of the electrons, so that if the field be sufficiently strong, it is possible that some of the electrons may pass out of the nuclear boundary, and if the core be not very stable, some of the protons constituting it may get out The commotion thus introduced by the external force will have some resemblance to radio-active disintegration, which must be attributed to the internal commotion of the nucleus An experiment was made with ferro-uranium, to see if the radio-active process cannot be accelerated by applying a strong field, but owing to the ionisation it was difficult to maintain the field for a sufficient length of time An investigation of the process of accelerating the disintegration must, therefore, be reserved for future experiments

The experimental procedure here sketched cannot be looked upon as the only one for effecting the transmutation, probably different processes will be developed and finally lead to industrial enterprises At present, there is no prospect of producing gold economically from mercury Experiments with various elements may lead to different transmutations, which will be of significance to science and industry Meagre as is the result, I wish to invite the attention of those interested in the subject so that they may repeat the experiment with more powerful means than are available in the Far East

H Nagaoka

The Institute of Physical and Chemical Research,
Komagome, Tokyo, May 26

The Quantum Explanation of the Zeeman Triplet

In his letter published in Nature of June 27, p 978, Prof W M Hicks raises some interesting points in connexion with the quantum theory of the simple Zeeman effect As Prof Hicks points out, the theorem of Larmor's usually taken as the basis of the theory does not define in any manner the relation between the orbits on which the rotation is superposed in the presence of the field on one hand, and the corresponding orbits before the imposition of the field on the other The supposition that these two sets of orbits are identical is, therefore, in no way justified on the basis of Larmor's theorem alone It can, however, be shown from purely classical considerations (see G A Schott, "Electromagnetic Radiation," Cambridge University Press, 1912, §302, p 317) that, to the first order in terms involving the field, the two sets of orbits are identical Schott's proof takes into consideration the induction

forces which act on the moving charges during the period of establishment of the field, whereas Larmor's theorem confines itself to the so-called Coriolis forces which, as Prof Hicks points out, act transversally on the moving charges, and hence cannot alter their energies

Prof Hicks proves in a simple case that the application of the Wilson-Sommerfeld quantum conditions to the Bohr hydrogen atom with reference to fixed axes (instead of the special rotating axes employed in the usually accepted theory) leads to no Zeeman effect at all as a first approximation A more general proof of this was given in a paper of mine about two and a half years ago (Roy Soc Proc , A, vol 102, 1923, p 529) in which I also put forward an alternative theory of the simple Zeeman effect which seems to me to answer Prof Hicks s purpose The theory is based on a slightly extended form of the quantum conditions which was first suggested by Prof William Wilson (Roy Soc Proc , A, 102, 1923, p 478), namely,

$$\int_0 \pi_i dq_i = n_i h, \qquad (i = 1, 2, \quad)$$

where $$\pi_i = p_i + eA_i,$$

p and q being the usual Hamiltonian co-ordinates, e the charge on the particle in question, and A the generalised magnetic vector potential These conditions are applied both in the absence and in the presence of the field, thus defining the orbits and their energies in both cases and the frequencies are then obtained from the energy relation $\Delta W = h\nu$ It is also shown that the relation between corresponding orbits defined by the extended conditions (*i e* orbits for which the quantum numbers are the same) is in complete accord with Schott's theorem , in fact the latter is derived as a necessary consequence of the quantum conditions themselves

A M MOSHARRAFA

The Manor House
Alphington, near Exeter, June 28

THE objection of Prof Hicks to the use of Larmor s principle (NATURE, June 27, p 978) is well founded, but the Zeeman triplet effect can be made to fit into the quantum theory by keeping strictly to dynamical principles The phase-integral $\int p dq$, for a variety of reasons, is, for the case of a magnetic field, to be replaced by $\int (\delta L/\delta q) dq$, where L is the Lagrangian function For the hydrogen atom

$$L = \tfrac{1}{2}m(r^2 + r^2\omega^2) - \tfrac{1}{2}Her^2\omega/c + e^2/r$$

Hence, on quantising,

$$mr^2\omega - \tfrac{1}{2}Her^2 = nh/2\pi$$

From this, for radial quantisation,

$$m^2\dot{r}^2 + n^2h^2/4\pi^2r^2 = 2e^2m/r - 2mC',$$

where $C' = C + nhe/4\pi mc$, $-C$ being the energy and H^2 being neglected Hence the " permitted value of the energy is

$$-(2\pi^2me^4/h^2)/(n+n')^2 + nhe/4\pi mc,$$

where n, n' are the azimuthal and radial quantum numbers

ARTHUR W CONWAY

Abbeyview, Dalkey, Co Dublin,
June 27

The Oogenesis of Lumbricus

IN a letter to NATURE (June 27, p 979) Prof J B Gatenby objects to certain comments upon his work made recently by Mr L A Harvey in a paper on yolk-formation in the earthworm (*Q J M S* 69, p 291) Mr Harvey is a student working in this department and it is on his behalf that I wish to protest against the tenor of Prof Gatenby's letter It is quite evident that Prof Gatenby has not comprehended clearly the contents of Mr Harvey's paper , for his letter contains misstatements, and these may do a considerable amount of harm unless speedily contradicted

Prof Gatenby accuses Mr Harvey of having been discourteous in saying that a glance at a paper of his (Prof Gatenby's) summarising what is known about the formation of yolk shows that " really very little is known " on the subject Mr Harvey was perfectly justified in making this statement—it is simply a statement of his opinion—and on this point I am in complete agreement with him The fact that Prof Gatenby disagrees with the statement does not make it discourteous The paper referred to, Prof Gatenby complains is an " old one " Its actual date is 1920, and if the advance since then is represented in Dr Brambell's paper (1924) on " Yolk," to which Prof Gatenby refers, it can safely be said that any advance made has been extremely small

The remarkable objection is then made that Mr Harvey, in studying yolk-formation in Lumbricus, is not justified in inferring any conclusions as to the similar process in Limnæa—a form studied by Prof Gatenby He gives no reason in making this statement However, he previously refers to a paper by a student of his as containing an account of *Molluscan* oogenesis Actually it deals with two forms and those both gastropods, and hence any general conclusions drawn must have been inferred from the study of those two forms

Prof Gatenby suggests that before criticising his work Mr Harvey should have repeated it While I admit that repetition might be desirable, it is obvious that Prof Gatenby has failed to grasp Mr Harvey's criticism, which is not that his observations are at fault, but that his deductions are This is made perfectly clear on p 292

Prof Gatenby's next point is that it was unfortunate that the egg of Lumbricus was chosen for the study of yolk-formation, as it contains no "real yolk" This is incorrect Yolk *is* present in the egg, and the criteria used for the recognition of that yolk were those advocated by Prof Gatenby himself This is fully explained on p 299 Further, Prof Gatenby objects that Lumbricus is a " special atypic annelid " and yet refers to Saccocirrus (apparently) as a typical annelid

It is the static conception of the cell to which Mr Harvey objects He regards it essentially as a dynamic concern—an equilibrium system in which the constitution of each constituent is a function of its surroundings—and because of this he considers that the technical methods and the reasoning adopted in modern cytological investigations into the question of yolk-formation are wrong If Prof Gatenby had read more carefully the introduction to Mr Harvey's paper he would have grasped this, and, in that event, it is to be hoped, would not have written his letter

H GRAHAM CANNON

Zoology Department,
Imperial College of Science,
South Kensington, July 2

Transmission of a Rosette Disease of the Ground Nut

THE important part played by insects in the dissemination of the virus diseases of plants is now recognised, and experimental proof of transmission by particular insects exists in a number of cases As a result of investigations during the past season, we are able to add one more to the list of those diseases of which the insect vectors are known

During recent years the cultivation of the ground nut or peanut (*Arachis hypogea*, L) in parts of South Africa has been seriously handicapped by outbreaks of a disease locally known as " rosette " The leaves of an affected plant are small, twisted and closely crowded, owing to the non-elongation of the internodes of the stem, giving the plant a bunched or rosetted appearance These leaves are generally yellow, but in many cases show definite mottling No seed is set by a plant diseased at an early stage of growth , and the yield is materially reduced by late infection

We believe this rosette disease to be identical with the East African " krauselkrankheit " of Zimmermann (" Der Pflanzer," 1907 and 1913), with the Javan " krulziekte " of Rutgers (Dept Landbouw, Nijv en Handel in Nederl Indie, Meded v/h Instituut voor Plantenziekten, 1913), and with the " bunching " or " clumping " recorded from West Africa and India

All investigators of this disease failed to attribute it to any parasitic organism or in fact to any definite cause and its nature remained little understood Zimmermann (1907) directed attention to a similarity between this disease and tobacco mosaic , more recently, the comparison was rendered the more obvious by extensions in our knowledge of the plant virus diseases so that pathologists generally assumed that the peanut rosette disease belonged to the virus group Support to this view is now afforded by experimental transfer of the disease Work carried out under our direction at Pretoria and independently at Durban has demonstrated the ability of *Aphis leguminosæ*, Theo , to transmit the disease In these experiments aphids, removed from rosetted peanut plants, were allowed to feed upon a single mature leaf of a healthy plant, suitably protected from the feeding of any other insects The characteristic rosette symptoms appeared afterwards in the young leaves of a large proportion of these plants Control plants, receiving identical treatment but protected from the feeding of any insects, remained healthy

During the course of this work collections were made of all the suctorial insects occurring upon diseased peanuts in the field Tests of more than two hundred individual jassids and fulgorids belonging to at least eight species afforded no single infection of the experimental plants

H H STOREY
Natal Herbarium, Durban
A M BOTTOMLEY
Division of Botany, Pretoria

X-ray Stimulation of Phosphorescence of Fused Silica

WITH reference to the recent correspondence in NATURE on the properties of silica, the following experiments on its phosphorescence after exposure to ultra-violet and X-rays may be of interest In the course of experiments to test the supposed fluorescence or phosphorescence of castor oil after exposure to ultra-violet light, it was found, working independently, that a photographic plate was blackened when exposed to the oil if the vapour were allowed to come in contact with it If, however the vessels containing the oil were carefully sealed no blackening was obtained, even when the oil had been previously exposed to ultra-violet light The vessels containing the oil were sealed glass jars having polished natural quartz lenses as windows, the exposure to ultra-violet radiation being carried out in these vessels

A fused silica weight thermometer exposed to the X-rays from a " Shearer ' tube for periods varying from half an hour to several hours, and then placed in contact with a photographic plate, produced considerable blackening whether containing oil or not, the fused silica being responsible for the whole of the effect, since oil exposed to X-rays, and then transferred to a quartz vessel after treatment, would not produce blackening

The polished lenses of natural quartz previously employed could not be stimulated with X-rays or ultra-violet light to actinic phosphorescence, but experiments have shown that various specimens of fused silica can be made to phosphoresce, and, moreover, may be seen in a dark room to fluoresce a faint green under the direct action of the X-rays, the luminosity apparently ceasing with the cutting off of the radiation

The silica continues at room temperature, to give off radiations for periods up to three weeks or a month after the original exposure to X-rays, but the phosphorescence is removed by heating to redness for two minutes

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The Sound of Lightning

SINCE my letter on the above subject in NATURE of May 23, several other instances have been brought to my notice Mr W H Dines has heard the sound six times certainly, and probably more , Mr J S Dines has heard it once, as has also my brother, Capt A L Cave, in London, when he was indoors , two other correspondents also write to say that they have heard the sound, one of them three times But perhaps the most remarkable case is that given in the *Marine Observer* for July (page 112) , Capt J Burton Davies of s s *Hurunui* reports that from 10 P M on July 30, 1921, to 3 45 A M on July 31, when in about lat 38 N and long 71 W , " a terrific electric storm was playing about the ship On three occasions the officer of the watch and myself were momentarily completely dazzled by flashes and it appeared that immediately before the flash we heard a tearing noise as of canvas being ripped violently , in fact, after the first of these flashes I caused the quartermaster to inspect the boat covers on boat deck to see if any were torn This noise interested me very much ' The fact that the noise was heard before the flash seems to indicate that it may have been caused by a brush discharge In any event, it proves that the noise must be real, and not an illusion like the rushing noise that some have imagined they have heard when watching a bright meteor, or the rustling sometimes attributed to the aurora

C J P CAVE
Stoner Hill, Petersfield,
July 2

Ether Drift and the Relativity Theory

IN reply to Prof Eddington's letter in NATURE for June 6 (vol 115, p 870), it will be enough to state that the type of ether motion alluded to in my first letter on this subject is, in spite of appearances, strictly *irrotational* For all details and the literature of the subject the reader may be referred to my paper on " Stokes-Planck's Aether " in the *Phil Mag* for February 1920, p 161 The irrotationality of Lorentz's solution to which the said motion corresponds is there sufficiently emphasised

LUDWIK SILBERSTEIN
Rochester, N Y ,
June 29

The Royal Observatory, Greenwich

THE Royal Observatory was founded in the reign of King Charles II to assist in the solution of the important and difficult question of determining longitude at sea The use of the method afterwards known as "lunars" had been suggested As the moon moves round the sky in a month, its position among the stars changes rapidly if, then, an almanac can be prepared giving the position of the moon among the stars according to the time of some fixed place, say Greenwich, the navigator can by observation of the moon determine the Greenwich time It is an easy matter to determine his local or ship time, and the difference gives the longitude In the seventeenth century the movement of the moon was not known with nearly sufficient accuracy for this method to be available, and even the positions of the fixed stars were very imperfectly charted The Royal Observatory was founded to remedy these defects, and Flamsteed, the first Astronomer Royal, was charged to make observations for "rectifying the tables of the motions of the heavens and the places of the fixed stars so as to find out the so much desired longitude at sea, for perfecting the art of navigation"

At the suggestion of Sir Christopher Wren the site for the Observatory was chosen on a hill in Greenwich Park A grant of 500*l* was made by the King, bricks were obtained from a disused fort at Tilbury, and the Observatory was built according to the design of Wren by Sir Jonas Moore, Master-General of the Ordnance The foundation was laid on August 10, 1675, and the building completed in the following year

The Rev John Flamsteed was appointed Astronomer Royal at a salary of 100*l* a year, but he was not provided with any instruments He brought with him an iron sextant of 6 ft radius, and Jonas Moore lent him a smaller one and two clocks The use of clocks as part of an observatory equipment dates from about this time Flamsteed made repeated appeals, but in vain, for money to erect an instrument in the meridian, which, he was convinced, would give greater accuracy and was essential for referring the position of the stars to the equinox In 1683 he erected a mural circle at his personal expense, dividing it with his own hands This instrument was not very satisfactory, but in 1688, as he was in better circumstances, he had a larger one constructed for him by Abraham Sharp, at a cost of 120*l* Sharp was his friend and assistant, and the two worked together for several years, determining the position of the equinox, the obliquity of the ecliptic, and the positions of sun, moon and stars The "Historia Coelestis," which contains an account of his methods and results, was published partly by himself and completed after his death by Abraham Sharp in 1725 It may be noted that Flamsteed was one of the first astronomers to use telescopic sights in his observations, as he was one of the first to make use of clocks His observations were a great advance on those of earlier astronomers, though they are now only of historical interest His catalogue of the positions of more than 3000 stars was corrected early in the nineteenth century by Francis Baily, who remarks that Flamsteed's British Catalogue is one of the proudest productions of the Royal Observatory

On the death of Flamsteed in 1719, he was succeeded by Halley, the friend of Newton, who secured the publication of the "Principia" He rendered many services to science, but is best known for his prediction of the return of the comet to which his name was afterwards given When Halley came to the Observatory, it was without instruments, as Flamsteed's executors had claimed those which he had used In 1721, Halley installed a small transit instrument Although the design is open to criticism, the instrument is of interest as the earliest specimen of a very important type In 1725 he had a large iron mural quadrant constructed by Graham With his instrument he made many observations, particularly of the moon

Bradley succeeded Halley in 1742 From his observations at Wanstead he had discovered the aberration of light in 1729 He continued his observations for many years and announced the discovery of nutation of the earth's axis in 1748 With the help of his nephew, who was appointed his assistant, he commenced observations with Halley's instruments He applied for funds for new instruments, and on the recommendation of the Board of Visitors, seconded by the Council of the Royal Society, was granted 1000*l* by King George II With this money he obtained an 8 ft brass quadrant, and a transit instrument of 4½ ft focal length and an object glass of 2 7 inches These were both made by Bird He also obtained a clock by Shelton, which is still in use at the new magnetic station at Abinger

With these instruments, Bradley laid the foundations of modern astronomy of position His skill in the design and use of his instruments rendered his observations far more precise than those of any of his predecessors The observations were collected and reduced after his death by his friend Hornsby They were later re-reduced by Bessel in his "Fundamenta Astronomiae," and again late in the nineteenth century by Auwers Our present knowledge of the direction of the sun's motion in space, and the existence of two star streams, is largely dependent on proper motions derived by comparing later observed positions of stars with those found by Bradley

Bradley's successor, Bliss, lived only two years after his appointment and was succeeded by Maskelyne in 1764 Maskelyne had been sent at Bradley's suggestion to observe the transit of Venus at St Helena in 1761 He made practical application during his voyage of methods of determining longitude at sea by lunar observations, and soon after his return published the "British Mariner's Guide," the forerunner of the "Nautical Almanac," which commenced in 1767 These works gave precise directions and presented astronomical data in the simplest and most suitable forms for their application to navigation During the forty-four years of his tenure of office, he was very assiduous in the observation of sun, moon, planets and a small number of the brighter stars, being specially attracted by the problem of determining the position at sea, to which the Observatory owed its origin His famous expedition to Schiehallion to determine the mean density of the earth was made in 1774 Towards the end of his life he found that the quadrants of Graham

and Bird needed to be replaced Pond, from observations made at Westbury in 1801–1806, had shown the advantage of using a complete circle instead of a quadrant Maskelyne gave instructions to Troughton for the construction of an instrument of this form but did not live to see the completion of this beautifully designed and excellently divided circle

On the death of Maskelyne in 1811, Pond was appointed Astronomer Royal The mural circle made by Troughton, and the transit instrument made by the same great artist in the year 1816, were the greatest improvements in astronomical instruments since the time of Bradley A second circle by Jones was added in 1825 Pond introduced the method of observing stars by reflection in mercury with one instrument while they were being observed directly with the other On the following night the rôle of the two instruments was changed Pond's observations were of a very high order of accuracy, so much so that Chandler traced in them the small changes caused by variation of latitude His Catalogue of 1112 stars was a most valuable contribution to the accurate determination of stellar positions Pond was also able with these instruments to show that several alleged discoveries of parallax of stars of the order of about 1″ were incorrect Another benefit which the Observatory derived from Pond was an increase in the number of assistants from one to six, resulting in a considerably increased output of observations

Airy succeeded Pond in 1835 and retired from his post in 1881 at the age of eighty His contributions to optics, tides, metrology and many practical questions are outside the scope of this article He introduced into the Observatory very orderly and business-like methods of reduction of observations and their regular and prompt publication Of the new instruments which he installed, the transit circle erected in 1851 has been the most valuable Its use led to a great increase in the number of observations He introduced the use of registration on the chronograph, a method invented in the United States He also introduced the system of telegraphic transmission of time daily from the Observatory to the General Post Office for distribution over Great Britain The great equatorial, erected in 1860, with a 12 5-inch object glass by Merz, was for a time the largest refractor in England Airy's reduction on a uniform system of the lunar and planetary observations made by his predecessors since the time of Bradley was a great contribution towards the formation of accurate tables of the movements of sun, moon and planets He extended the scope of the Observatory by the introduction of magnetic and meteorological observations

Christie succeeded Airy in 1881 and retired in 1910 During his tenure of office, photographic observations became a part of the regular work of the Observatory The daily photography of the sun, and measurement of the position and size of the spots, was actually begun in Airy's time but was developed considerably by Christie A share was taken by Greenwich in the photographic chart and catalogue of the heavens, and for this purpose the astrographic telescope was obtained Additions to the equipment were made in the 28-inch visual equatorial, used mainly for observations of double stars, in the altazimuth, essentially a transit instrument which can be placed in any azimuth, and in the Thompson equatorial, consisting of a 26-inch photographic refractor and a 30-inch reflector, the gift of the eminent surgeon Sir Henry Thompson The large increase in the buildings and instruments made in Christie's time were very necessary for the Observatory to maintain its high position A great extension took place in the output of the Observatory in meridian astronomy The part assigned to Greenwich in the astrographic chart and catalogue was carefully carried out A thorough determination was made of the solar parallax by observations of Eros Valuable series of double star observations were made with the 28-inch telescope, and the two telescopes of the Thompson equatorial were employed on a variety of problems

In conclusion, it may be truly said that the original intention of the founders of the Observatory has been carried out consistently for 250 years The pursuit of the practical problem of the determination of longitude has involved long series of observations which have contributed very largely to our knowledge of the movements of sun, moon and planets At the present time a larger share is given to questions of purely astronomical interest, but the practical applications of science are still interwoven with them in observations of position of sun and stars, the distribution of time, the care of the Navy chronometers and the compilation of magnetic charts F W D

Problems of the Rhone Delta[1]

By R D OLDHAM, F R S

IV

WHEN, in 1711, the Rhone broke away from its former course to the sea, it more and more adopted the new channel until, in 1724, the older one was definitely closed to navigation, the river, following the course it still maintains, had established its channel to the sea-face, and in 1725 the town of Arles complained of the difficulties of the new mouth, where extensive sand-banks had formed The river, in fact, having reached the open sea, was subject to conditions which are described in reports of the nineteenth century, the deposit of silt, where the current is checked on reaching the sea, combined with the effect of the waves in sorting and casting back the coarser grained material, together with the absence of any tidal scour, led to the formation of low sand-banks, known as *they*, barely emerging from the water when the sea-level was low, and submerged when it was raised by a river flood or an onshore wind The main channel of the river was blocked by a well-defined bar, on which the water might reach a depth of a couple of feet, but was mostly under a foot, and through this bar a narrow and constantly changing pass admitted, in favourable circumstances, vessels of up to 6 feet, but usually not more than 4½ to 5 feet, in draft Only in fine weather was this

[1] Continued from p 54

narrow channel practicable, and for 120 days in the year the passage was too dangerous to allow of any vessel entering or leaving the river, even when the channel was otherwise clear, vessels might find that it had shoaled too much to admit them, and have to tranship their cargo into lighters of shallow draft

Various attempts were made to overcome these difficulties The first was the construction of a canal from Arles to Port de Bouc, but the dimensions of the canal were too small to render it serviceable The next scheme was to restrict the river to a single narrow outlet, in the hope that the scour of the current would

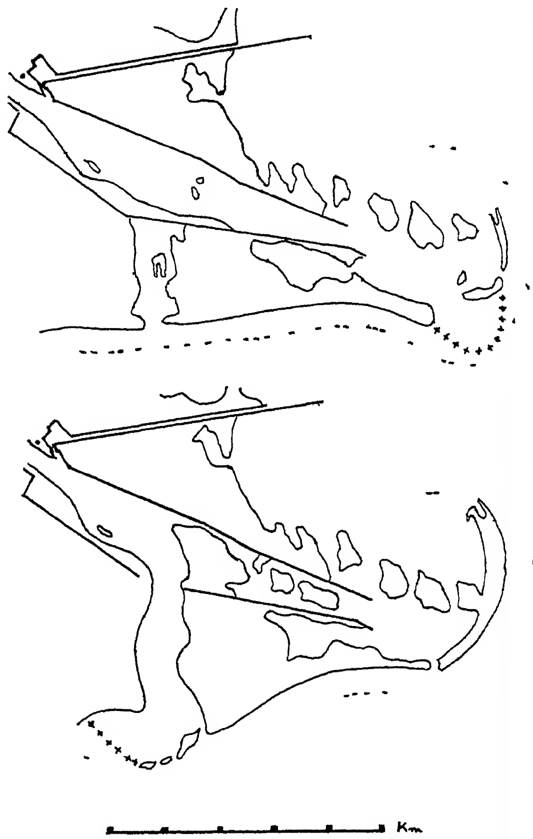

FIG 5 —Mouth of the Rhone in 1893 and 1913 Dotted line marks the contour of 5 m depth of water

maintain a deep channel, and in 1852–55 embankments were carried along both banks to the mouth, the last of the lateral outlets being closed in 1856 At first, success seemed to have been attained, the channel deepened to 12 feet, but in a couple of years a new bar had formed, further out, and the channel shallowed to its old depth of 4 to 6 feet This plan having proved a failure, it was decided to cut a ship canal from the Gulf of Fos and form a port on the river near the Tour St Louis, and by 1871 the port and canal, with its locks, were completed This proved a modified success, the Port of St Louis established itself as one of the principal of the minor ports on the Mediterranean coast of France, and would doubtless have attained greater prosperity but for malaria, with which this part of the delta is infested

Meanwhile the mouth of the Rhone had been advancing south-eastwards at a rate of about 60 metres a year, and threatened to block the fairway to the Port of St Louis, so it was decided to reopen the Grau de Roustan, which had been the principal lateral outlet of the river on the western side In 1893 the embankment with its stone revetment was removed, and a narrow cut opened to the river through the land which had been formed since the embankment was made This cut, as was expected, was widened by the river, which rapidly adopted this channel as its main outlet to the sea, the previous main channel becoming more and more blocked with sand-banks At the end of twenty years a complete change had come over the mouth of the Rhone The channel of 1893 had been almost completely filled up, only a narrow and shallow channel remaining, the low *theys*, the bar at the mouth, had been washed away by the sea, and a continuous barrier of dry sand, crowned with sand dunes, formed at about 700 metres behind the previous position of the mouth The old Grau de Roustan had become the sole outlet of the river, which had built up new land to 1200 m in advance of the old shore-line, and the mouth was blocked by a row of *theys* and a bar, like that which had formerly blocked the mouth of the river, and such as will always be formed where a silt-bearing river enters an almost tideless sea

It is of some interest to compare this description of the conditions at the mouth of the Rhone, in the nineteenth century, and the measures undertaken to overcome the difficulties, with the accounts which we have of the campaigns of Caius Marius in 103–102 B C, in the course of which he encountered the same difficulties and adopted similar measures to overcome them Plutarch, in his life of Marius, says that the mouth of the Rhone being barred and almost filled up with sand and mud, the passage became narrow, difficult, and dangerous for the ships which brought provisions, so Marius, bringing his army, drew a great trench and, by turning a great part of the river, brought it to a convenient point on the shore where the water was deep, and this still retains the name it took from him To this account Strabo adds that, after the defeat of the barbarians, Marius gave the canal to the people of Marseilles, who derived great revenue from tolls on ships passing along it, notwithstanding the entrance continued difficult to navigate, on account of the deposits and the flatness of the country, so that in foul weather the land could not be discerned, even when one was quite close

The account which these writers give of the entrance to the Rhone shows that conditions were the same as in the nineteenth century, and suggests that what Marius did was analogous to the solution arrived at some 2000 years later, when the St Louis canal was dug, and Strabo's account of the difficulties which arose, in later times, is matched by the formation of sand-banks, and a bar, across the Grau de Roustan, when that became the main channel of the Rhone The digging of a canal a mile and a half long, or very likely less, would not have been too great a work for an army to undertake in the time at his disposal, once dug, access would be made easier for a while, but in course of time, as the river abandoned its old course and adopted the new one, all the difficulties and dangers of the entrance to the river would reappear That no trace of this canal

remains is not to be wondered at; the river continued to bring down silt and extend the delta for eight centuries after it had been dug, and then came the subsidence which caused any trace of the work of Marius, necessarily lying near sea-level, to be buried under twelve to fifteen feet of silt or water.

During the last two centuries, in which the river has been building up the projection from the old sea-front of the delta, which has reached a length of about 9 kilometres, and has added nearly 40 square kilometres to the area of the delta, changes of a different character had been taking place farther west. The river, during the period in which it had flowed in the channel of the Vieux Rhône, had built up a prominence of some four or five kilometres, but as soon as the course of the river had changed, and the transport of fresh material had ceased, this prominence was attacked by the waves of the sea, and rapidly removed. Opposite the Faraman lighthouse, the recession of the sea-front amounted to about 4.5 kilometres between 1710 and 1870, after which equilibrium seems to have been nearly established and recession became slow. The material removed from this part of the coast was mainly swept to the westwards, where part of it went to form the projection of the Pointe de Beauduc, but part was drifted round the point, to form the continuous barrier and sandy beach which borders the Golfe de Beauduc. Maps of the seventeenth and early eighteenth centuries show no trace of this, the Pointe de Beauduc is not indicated, and the Golfe is bordered by an archipelago of islands, separated by channels, open to the sea and penetrating inland to the Etang de Vaccarès. The date at which these conditions were altered, by the formation of a continuous beach and barrier along the coast, cannot be determined with precision, but in the Cassini map, constructed in the 'seventies of last century, the barrier is shown, and the sea-face is almost as mature in form and outline as on the most recent maps, so we may put the transition, from the immature to the mature form of the existing sea-coast, as having taken place round about the close of the eighteenth and the commencement of the nineteenth centuries.

This completes the cycle of changes which this region of the Rhone delta has undergone, since definite information commenced with the advent of the Romans. At the outset, the extent and outline was not materially different from that of the present time, but the land stood about fifteen feet higher above sea-level than nowadays, the extensive salt lakes and marshes were all dry land, and the Camargue was a fertile, populous, and prosperous region. Along the sea-coast there were probably lagoons, separated from the sea by a continuous barrier, sand dunes and sandy beach, which swept round the coast in smooth and even curves, characteristic of a mature coast-line. At the mouth of the river, which lay farther west than the present mouth, a projection had been formed by the alluvium brought down by the river, exactly analogous to that which has been built up along the present channel. These conditions continued during the rise and fall of the Roman dominion in Gaul until, in the eighth and ninth centuries, a subsidence of the land took place, by which not only were the low level deposits along the coast and at the mouth of the river plunged beneath the sea, but a larger part of the higher ground behind them was also brought below sea-level. The matured coast-line disappeared and was replaced by the immature condition of an archipelago of islands, and the river, instead of debouching in the open sea, ended far inland in a land-locked inlet of shallow water. Then, for some eight centuries or so, the river was occupied in filling up the submerged areas of the delta, and in pushing forward its mouth until, about the middle of the seventeenth century, it again reached the sea-front, and about a century and a half later the continuous barrier and beach, with the curved outline of maturity, was again established. Along the sea-coast the delta had resumed the general type, and approximately the outline, of earlier times, but, in the interior, large areas of what was then dry land are still occupied by salt water lakes and marshes, which have been protected, by accidents of surface configuration, from the deposits of the river, and still remain much as they were left at the close of the period of subsidence.

Evolution and Intellectual Freedom

SINCE going to press last week, we have been favoured with several further messages on the subject of the campaign in the United States against the teaching of the principle of biological evolution. We are glad to be able to publish these expressions of opinion upon the attempt thus being made to restrain intellectual freedom and progressive thought. As to the trial now being held at Dayton to test the validity of the anti-evolution law of the State of Tennessee, there can be no question that leaders in all departments of intellectual activity in Great Britain regard it with amazement. It is not for us to suggest that a teacher was justified in breaking the law of a State of which he was the paid servant, but what does astonish us is that the citizens of the State should tolerate a law which makes references to evolution and the descent of man illegal. So far as actual teaching of these subjects in schools is concerned, most men of science would not insist upon attention being devoted to them; but when the ban extends to colleges and universities, the matter becomes of prime importance.

There can be no research for truth in Nature if natural truth, including that of the creation of the universe, the earth, and man, has to be regarded as revealed, once for all, in the Biblical record. It would be impossible for any teacher of science to be true to his intelligence and yet give instruction under such conditions. There is, fortunately, no probability of limitations of the kind advocated by Mr. W. J. Bryan and the Fundamentalists being placed upon biological teaching in Great Britain; and for the sake of human progress, we trust that the reactionary movement which they represent will fail of its object. The attack has come from the advocates of traditional doctrine and not from workers in scientific fields, who ask only to be free to extend natural knowledge by research and instruction, without being bound by the words of any master. No one supposes that the problem of organic evolution has been solved, but of the fact of evolution there is not the slightest doubt, and only by further inquiry can we understand fully its course and significance. Whatever Mr. Bryan and his followers may

insist upon as regards belief, science declines to accept finality in the position of natural knowledge at any epoch, or to construct a standard which all discoverers must follow As Huxley said, when unveiling Darwin's statue in the Natural History Museum, South Kensington, in 1885, science "commits suicide when it adopts a creed"

We need scarcely say that it is not our wish to have a discussion in NATURE upon Genesis and modern science, or religious belief and scientific evidence Our sole object in taking up the subject of the prohibition of the teaching of evolution in certain States of the United States, and in inviting opinions upon this action from a number of leading authorities, has been to afford support to our colleagues fighting for scientific truth and progress against dogma and stagnation We trust that the additional messages subjoined will give them the strength and courage they need to secure for them the position of intellectual freedom established in Great Britain many years ago, and existing unchallenged to-day

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Prof J GEORGE ADAMI, M D, F R S,
Vice-Chancellor of the University of Liverpool

NOTWITHSTANDING "Main Street," it is difficult for us in the old country to realise the state of public opinion throughout the greater part of the United States outside the larger cities difficult to realise how the minister (be he Methodist or Baptist, Congregationalist or Lutheran) and the Sunday School dominate the community In the small country town—and every village aspires to be a town—there is no society, and no public opinion, save that centring round one or other church He is out of society who is not a church member, and it is a commonplace for "Aunt Susan," a representative of one of the oldest families in the town, to conduct the Sunday School class, she being close upon seventy, and her class consisting of the elderly farmers of the locality and their wives and associated elderly spinsters, who have, as it were, grown up under her wing Visit the farms and other houses of the town and you will find no solid literature that is not theological of an approved type, and of that but some three or four books Read the local papers and you will see in them little beyond local news, of church teas and picnics, of auctions, of local weddings and funerals in most intimate detail, with a long column of notes upon the doings of local personages, how this one has left for New York or that one returned from Chicago, with, of course, full information regarding local and league doings in baseball They contain absolutely no news about the outer world, no discussion of topics outside the range of the Sunday School Save personal gossip and local happenings, all other topics are taboo

The "Aunt Susans" and their elderly classes in their turn dominate the minister For his peace of mind—and bread and butter—he dare not venture beyond the bounds of the teaching delivered over long years by Aunt Susan All the leaders of the community would be scandalised and up in arms They pay him, and he has no security of tenure As a consequence an intellectual stagnation and aridity, a narrowness of outlook and a supreme confidence that opinion in Pumpkin Corner is the only possible and only right opinion, unbelievable as they are to us, are actualities throughout Tennessee and agricultural North America

It is this that makes possible and that explains the proceedings which have led to the Dayton trial It is this state of affairs that explains the lack of theological progress which in itself is adequate to explain the situation in Tennessee, Oklahoma, Florida, and many other States

It is eminently likely that in the trial at Dayton the arguments for and against evolution will not be reached There is a matter yet more fundamental, politically speaking, than that upheld by the Fundamentalists, namely, the constitutional right to fetter liberty of thought It is a question of supreme moment whether in the "Land of Freedom" the Tennessee decision does not contravene the Declaration of Independence and the basal right of every citizen of the United States to a reasonable liberty

Prof C LLOYD MORGAN, D Sc, F R S,
Emeritus Professor of Psychology, University of Bristol

THROUGH the courtesy of the Editor of NATURE I am permitted to enrol my name among those who wish to express their sympathy with advocates of the free and untrammelled spread of evolutionary teaching throughout the length and breadth of the United States of America

I am one of those who believe that all advance in the order of Nature of which we ourselves, body and mind, are constituent parts exemplifies evolutionary progress This may be true or it may be false If it be true, no legislative authority can suppress it, if it be false, it will not be through legislative authority that its falsity will be demonstrated

But I am also one of those who believe that there are thousands in America and elsewhere who find in evolution a stay and support of their deepest religious convictions If this be so—if, as I think, it be plain matter of history vouched for by these thousands of religious people—the position, as I see it, is this by excluding evolutionary teaching in the schools and colleges of this or that State, an avenue to the full and free development of religious faith and observance is arbitrarily barred by legislative enactment

Unless those who attend these schools and colleges differ markedly from those young folk with whom I have been for many years acquainted in England, there will always be a certain percentage who will find that the form of theological doctrine, whatever it may be, that is prescribed under authority is such as they cannot honestly accept In my experience a large proportion of these honest and perplexed young people scarcely know what evolution means When they have learnt what light it may throw on the problems that perplex them, they rejoice in their new sense of freedom from the bondage that has been enforced by authority

The Right Rev H HENSLEY HENSON,
Lord Bishop of Durham

IT is difficult for an educated Englishman, and *a fortiori* an educated English clergyman, to regard the proceedings in Tennessee without astonishment and contempt The scientific theory of evolution, popularly associated with the name of Charles Darwin, has

established itself so firmly in the acceptance of all serious students in Great Britain as to be rather an axiom of thinking than a specific doctrine Of course the concept of development is far older than Darwin Theologians and historians discovered very quickly that the biologists were proclaiming a truth which, in other connexions, they had necessarily recognised, and the conflict between religion and science which in the middle of the last century agitated Great Britain has, so far as the issue of evolution is concerned, completely died away Literalist theories of Biblical interpretation and irrational beliefs as to ecclesiastical authority do from time to time occasion friction between religious people and men of science, but such theories and beliefs are evidently losing their hold on the minds of thoughtful Christians, and now move more annoyance than reverence in the general mind

Freedom of thought is the condition of sincere religion Freedom of research and teaching is the first principle of academic life It is incredible that such freedom should be prohibited in American universities The accounts of Fundamentalism which come to us across the Atlantic indicate nothing more respectable than the injustice and absurdity of religious panic, such as was familiar enough in England at the time of the controversies occasioned by "Essays and Reviews" Mr Bryan's pronouncements belong to the pre-scientific age, both in temper and substance They are not creditable to the United States, and will be remembered as the vehement protests of a bigotry which is equally self-confident and obsolescent They can have no permanent effect on American thought and life

Rev R J Campbell, D D,
Holy Trinity Church, Brighton

That a ban should be placed upon the teaching of evolution in publicly supported educational institutions in the United States or elsewhere is a puzzling fact Probably it is in some degree the outcome of what is called the "Fundamentalist" controversy in religious circles in America, a controversy which has had few repercussions over here and is not likely to have many in the future That such crises should be possible is evidence of what competent observers have long known, that American mentality, taken on the whole, differs considerably from that of Great Britain I do not mean that it is necessarily inferior, in fact we know it is not, in some ways it is fresher, more alert, more productive, and there are certain fields of research and enterprise in which the American intellect leads the world

Nor need we assume that the attitude taken by the authorities who exclude the teaching of evolution from the educational curriculum is wholly obscurantist It is not There is no country in the world wherein a generous idealism is more earnestly cherished than in the United States, nor, appearances notwithstanding, one wherein a soul-deadening materialism meets with more energetic protest Probably, therefore, it is less the teaching of evolution than its supposed materialistic implications that an influential section of public opinion disapproves of and this is not a bad sign

All the same, it is an impossible position to take up Neither religion nor morals can be safeguarded by proscribing free inquiry in any department of human interest It is sure to defeat itself and to produce the opposite of what is intended There can only be one issue to the present conflict of opinion The assured results of modern science must and will become accessible to civilised mankind everywhere

Prof J W Gregory, D Sc, F R S,
Professor of Geology, University of Glasgow

The struggle in the United States over the teaching of evolution is the newest form of the age-long contest for freedom of scientific opinion It is a warning of the dangers of elementary education becoming a State monopoly Whether the American Constitution can be interpreted to declare the proscription of Darwinism in State schools illegal seems to be doubtful The only relative clause appears to be an addition to the first Article of the Constitution, that addition enacted that there should be "no establishment of religion or prohibition of the free exercise thereof" and there should be no "abridging the freedom of speech" Freedom of speech in the schools is as important in the intellectual development of a nation as is the freedom of public discussion of political issues

Evolution is now essential to the understanding of science and of natural and moral philosophy, and the prohibition of its teaching in the schools would be as fatal to sound education as would be the prohibition of the multiplication table and the axioms of geometry to the study of mathematics In any State wherever education is compulsory, interference in teaching is a most serious abridgment of freedom of speech Such a State has no moral right to compel its public school teachers to teach what they regard as error or to adopt a system which renders satisfactory education impossible Hence the Article in the Constitution that guarantees the United States "no abridging of freedom of speech" may justly be applied to public school teaching and to the prevention of exclusion from the schools of the essential foundations of education

Rev J O F Murray, D D,
Master of Selwyn College, Cambridge

The object of those who are promoting the prosecution of Mr J T Scopes is to safeguard faith in the divine inspiration of holy scripture Sympathising with their object, I would plead with them most earnestly to consider whether the right way to attain it is to prohibit the teaching of any conclusions that seem at first sight inconsistent with it

If we believe that "by the word of the Lord were the heavens made," must we not believe that patient study of the stars will help us to think God's thoughts after Him? Ought we not to listen to what He is saying to us through the works of His hands? May we not hope to attain thereby to a clearer understanding of what He is saying to us through the written word? Dare we forbid any astronomer to make any suggestion as to the constitution of the universe unless he can make it fit with what we regard as the plain meaning of particular texts of holy scripture? In so doing is it really the infallibility of holy scripture that we are trying to maintain or the infallibility of our interpretation?

The method has, no doubt, been tried The Roman Inquisition tried it with Galileo Is that an encouraging precedent ?

R R MARETT, D Sc,

Fellow, Tutor, and Dean of Exeter College, Oxford

I AM sure that, without help from me, the citizens of the United States are quite capable of suppressing their own obscurantists Theirs is not the country to go back on the principle of the freedom of thought Hence I would excuse myself from testifying to the doctrine of organic evolution, and incidentally from having to consider which particular version of it I am prepared to support at the present moment Rather I would remind my scientific brethren over the water, lest they take the matter too seriously, and hold themselves to be shamed in the face of the world, that there are plenty of worthy folk over here just as narrow in their outlook I have myself been invited to lecture on anthropology to a denominational congress—held, I am glad to say, not in the British Isles but in a neighbouring country—on condition that nothing should be said about evolution For the rest, I have had to do at Oxford with Rhodes scholars coming from the obscurantist States, and have found them apparently as well educated as the rest, whence it is perhaps to be inferred that the rising generation will not limit the circuit of their musings to suit the antiquated prejudices of their elders

Obituary

PROF B GRASSI

THE death of Prof B Grassi, at Rome, on May 4, robs zoology of an ardent devotee and Italy of her most famous zoologist

Giovanni Battista Grassi was born at Rovellasca (Province of Como, in Northern Italy) on March 27, 1854 He received his early education at a private school, and then entered the University of Pavia as a medical student But after qualifying in medicine he threw himself whole-heartedly, for the rest of his seventy-one years of life, into the study of zoology—a subject for which he had evinced, even at an early age, a singular aptitude (He always called himself—and posterity will endorse his definition—*zoologo*, and not *medico*) He studied first at Messina (with Kleinenberg) and afterwards in Germany—at Heidelberg (with Butschli and Gegenbaur) and at Wurzburg (with Semper) In 1883 he was appointed professor of zoology in the University of Catania (Sicily), where he remained until 1895, when he was promoted to the chair of comparative anatomy in the University of Rome In 1897 he was elected a national fellow of the Royal Society of Italy (R Accademia dei Lincei), and in 1908 he was made a Senator of the Realm until the day of his death he was—scientifically—one of the most productive members of the University, the Academy, and the Senate Our own Royal Society bestowed the Darwin Medal upon him in 1896, but never elected him a foreign member

Grassi's contributions to zoology are so many, so varied, and so great, that they cannot be adequately reviewed in a few words He began his researches while still a student, and continued them unremittingly until the end of his life—despite his multifarious cares of office (He could boast, but a year ago, that he had always given more lectures every year than the University required, and had never once missed a sitting of the Senate) Though a man of apparently feeble physique, and handicapped from childhood by defective eyesight, he was possessed of immense energy and ardour and he never spared himself He used to say that mankind is composed of those who work, those who pretend to work, and those who do neither, and there can be no doubt that he himself belonged to the first class An accomplished field naturalist, with expert morphological and systematic knowledge of many groups of animals, he was also an accurate and original observer and an indefatigable experimenter—and one, moreover, who was always master of the literature of his subject Consequently, his best works already rank among the zoological classics

Many of Grassi's outstanding researches were done in collaboration with pupils and colleagues, among whom may be particularly mentioned Bastianelli, Bignami, Calandruccio, Feletti, Anna Foà Noè, Rovelli, Sandias, and Topi Since many of the problems which he successfully attacked—either alone or with the help of others—are not only of great zoological, but also of great medical and economic importance, and therefore bound up with various vested interests, it is scarcely surprising that his own restless research and unquenchable thirst for knowledge sometimes brought him into sharp conflict with opponents and rivals, and occasionally even with his fellow-workers and unhappily the controversies aroused by some of his investigations have gained wide publicity, and have even tended—in certain quarters—to obscure the indisputably great merits of these investigations themselves He recently remarked, publicly, that he "would have led a tranquil life if he had not engaged in the study of malaria and other burning questions which have a practical application" This is pathetically true, though one may be permitted to question it

Of Grassi's works there is space to mention only some of the greatest His earliest studies of the life-histories of intestinal worms and protozoa—begun in 1876 and continued for some dozen years—are familiar to all specialists, and contain many important observations and discoveries He gave, for example, the first accurate account of Giardia (Lamblia), and was the first to ascertain (partly by experiment upon himself) the method by which *Entamœba coli* and *Ascaris lumbricoides* are transmitted from man to man, and he was also the first to show that the cestode Hymenolepis completes its development without passing through an intermediate host Curiously enough, it is only within recent years that these and others of his early observations have been verified and finally accepted

In 1883 Grassi published his classical Naples Monograph on the Chætognatha, a peculiar group of marine animals and ten years later (1893) he published (with

Sandias) his famous observations on "The Constitution and Development of the Society of Termites"—one of the finest entomological works ever written In the course of this work he was led to make a detailed study of the peculiar protozoa with which many termites are infested, and these studies—begun in 1885, and ending with his extensive and beautifully illustrated memoir of 1917—are scarcely less important than those which he has published on the termites themselves

In 1887 he began (with Calandruccio) a very different investigation which ultimately yielded results no less remarkable—his study of the life-history of the eels The development of the eel is a problem which had puzzled biologists from the time of Aristotle, but in 1896 Grassi was able to announce that he had solved it, in its general terms, though full details of his work were not made known until 1913, when his magnificent monograph on "The Metamorphosis of the Muraenoids" appeared

From about 1890 until 1892 Grassi was also occupied (with Feletti) in studying the malarial parasites In 1898 he returned to this subject with renewed energy, and succeeded in 1898 and 1899—with the collaboration of Bignami and Bastianelli—in solving once for all the problem of the mode of transmission of human malaria He was then able to demonstrate that certain mosquitoes (Anopheles), and these mosquitoes only, convey malaria from man to man, and he worked out, for the first time, the entire life-history of the human malarial parasites in these insects The importance of these discoveries needs neither emphasis nor advertisement His great monograph—"Studies of a Zoologist on Malaria"—was published in 1900 It is still unsurpassed, and is universally acknowledged by protozoologists as one of the classics of their science

About 1905 Grassi turned his attention to another organism of vast economic importance—Phylloxera, an insect which has done incalculable damage to the vineyards of Europe since its accidental introduction from America some sixty years ago With various collaborators (Foa, Topi, and others) he continued to labour at the biology and control of this insect until the end of his life His most important publication on the subject—issued by the Italian Ministry of Agriculture in 1912—has recently been described by a distinguished entomologist as "a milestone in the history of entomology"

Another important entomological work by Grassi is his memoir on the sand-fly (Phlebotomus) In this he gave (1907) the first good account of the structure and life-history of an insect which has recently attracted much medical notice, owing to the part which it appears to play in the dissemination of more than one human disease During the last few years of his life Grassi returned again to the study of malaria and its prevention, and published—among other works—a series of most interesting papers on the biology of mosquitoes

These are some of the works for which the name of Battista Grassi will ever remain famous in zoology—both pure and applied—and in medicine Severally his contributions to helminthology, to entomology, to protozoology, or to ichthyology, would be sufficient to establish the reputation of a lesser man in any one of these sciences taken together, as the work of a single individual and his assistants, they constitute a record of achievement almost unparalleled in the history of zoology CLIFFORD DOBELL.

WE regret to announce the following deaths

Commendatore Giacomo Boni, director of the excavations in the Forum, Rome, and on the Palatine where he made important archæological discoveries in the Temple of Vesta and on the site of Domitian's Palace, respectively, on July 7, aged sixty-six years

Dr Charles Forbes Harford a founder and the first Principal of Livingstone College, Leyton, on July 4, aged sixty years

Dr Felix Klein For Mem R S and Copley medallist of the Society, professor of mathematics in the University of Gottingen, who has added to our knowledge of non-Euclidean and carried out researches in the theory of functions, on June 22, aged seventy-six years

Current Topics and Events

IN 1915 a new chapter was opened up in the cancer mystery by the discovery of Yamagiwa and Ichikawa that cancer can be successfully induced in rabbits by the prolonged application of gas works' tar This result was soon confirmed, and during the last ten years a large number of tumours have been produced in mice, rabbits, and even in fowls In addition to cancer in the strict sense, other malignant tumours have developed as a result of the application of tar products There is no longer any doubt that the induced tumours are true blastomata They possess every attribute which has been associated with the idea of malignancy Tar is, of course, not the only chemical irritant which produces tumours, but it is the one that most readily does so under experimental conditions It is also known that different tars vary greatly in their cancerogenic properties The actual agent in the tar has been sought, and although not yet completely identified, a large body of knowledge has already grown up on the subject Apparently the acids and bases of tar can be removed while the cancerogenic agent remains

A SHORT time ago, E L Kennaway, of the Cancer Hospital Research Institute London, obtained results which pointed to the conclusion that isoprene compounds prepared at about 820° C are more active than the original coal tar from which they are obtained In a more recent paper (*Brit Med Journ*, 1925, ii p 1, July 4) Kennaway has made a further important contribution to the cancerogenic properties of "tars," by showing that acetylene heated to 800°-900° C is capable of producing tumours A Californian petroleum, in itself apparently incapable of producing cancer, became so when heated to 800° C in a current of hydrogen More extraordinary still, he found that human skin or yeast dried and heated to 920° C produced malignant tumours in mice Although these products, up to the present, can only be produced at

high temperatures, "it is possible," as Dr Kennaway says, "that the body at its own temperature takes months or years to produce a quantity of some substance sufficient to influence the growth of a few cells only", whether this is so or not, it seems probable that we are getting definitely nearer the solution of the cancer problem.

YET another step in the progress of our knowledge of cancer is promised in the announcements which have appeared of a paper by Dr W E Gye, to appear in the *Lancet* of July 18 At the time of writing no details are available but it would seem that Dr Gye, who has been supported by the Medical Research Council and assisted by Mr J E Barnard and Dr J A Murray, the latter of the Imperial Cancer Research Fund, has discovered a filter-passing organism in cancers of birds, rodents, and other mammals, including man The organism itself however, does not give rise to cancer when injected into healthy animals, it requires the presence of a so-called specific factor obtained by injecting a tumour extract from the species of animal which is being used for experiment In the presence of extract of a sarcomatous tumour freed from the newly discovered organism, the organism itself, whatever its source, is able to cause sarcomatous growth in an animal of the species from which the extract has been made Extracts of carcinomatous growths would appear to be ineffective Mr Barnard's work on the use of ultra-violet light and other short-wave radiation for photographing, under the microscope, objects of very minute size, is well known, and his share in the present work has apparently been concerned with photographing the organism If the discovery is fully substantiated, it should mark an important advance in medical knowledge

ON Monday, July 13, the King, who was accompanied by the Queen, opened the new house of the British Medical Association, Tavistock Square, London, in the presence of an assembly of medical representatives from the Dominions and Colonies, from many organisations in Great Britain, and from the continental countries of Europe and a special delegation from the American Medical Association Shortly before the arrival of the King and Queen, the memorial gates at the entrance of the courtyard of the building were dedicated by the Archbishop of Canterbury to the memory of the 574 members of the Association who lost their lives in the War The King and Queen were attended by Mr Neville Chamberlain, Minister of Health, and proceeded to the Great Hall of the new building, where the chairman of the Council of the Association, Dr R A Bolam, read an address outlining the origin and aims of the British Medical Association Throughout its existence, the Association has striven to maintain the traditions of the medical profession and to keep its members alive to the advance of the science and art of medicine Medical men, he said, have a duty not only to their patients but also to the community in the protection of public health Reference was also made to the fact that there are now no less than 2250 women members of the Association In his reply, the King remarked on the great increase in membership and usefulness of the Association since its foundation in 1832 The importance of qualifying examinations and prescribed training as a preliminary to admission to the Medical Register was emphasised, with the warning that 'vigilance must always be exercised in order that your profession may keep abreast with the advance of science" In this connexion reference was made to the value of post-graduate study Passing on to the relation of the medical practitioner to public health the King said that the welfare of the peoples of the British Empire "depends largely upon an efficient and well-organised health administration," and referred to the medical practitioner as a "missionary and teacher of public hygiene and of personal health"

ON Thursday, July 9, the Sargant Laboratory of Plant Physiology at Bedford College for Women, London, was opened by Lord Justice Sargant The Principal, in introducing Lord Justice Sargant, spoke of the sympathetic interest Miss Alice Sargant had shown towards Bedford College and of the important share she took in furthering the acquirement of the present unique site in Regent's Park Upon her death Miss Sargant had bequeathed a sum of 1000*l* for the furnishing of a library and herbarium in the Botany Department and for the erection of a physiological greenhouse The War intervened before the latter project was carried out and post-War conditions rendered the unexpended balance inadequate for the purpose intended Recently, however, as the result of a legacy, the Council of the College has been able to provide a sufficient additional sum to permit the erection of a small laboratory and experimental greenhouse

IN declaring the new Sargant Laboratory of Plant Physiology open, Lord Justice Sargant acknowledged the kindly thought that had connected his sister's family name with the laboratory He pointed out that Alice Sargant's contact with botany was artistic and literary rather than scientific, and that in his own mind he would always associate with the building the memory also of his other sister, Ethel Sargant, who took a keen interest and an active part in scientific botany A vote of thanks was moved by the chairman of Council, Sir Wilmot Herringham, and seconded by the head of the Botany Department, Prof W Neilson Jones, after which the new laboratory was inspected Among the exhibits were a collection of portraits of botanists and others after whom plant genera had been named, together with specimens of the plants concerned, demonstrations of researches carried out by various members of the Department of Botany, apparatus for the study of plant physiology, and a number of interesting plants The Botany Department of Bedford College is fortunate in possessing a small but well-stocked botany garden, inspection of which provided an attractive item in the entertainment of those who attended the ceremony on July 9 The position of the new laboratory in close proximity to the garden ensures a supply of suitable plant material for work in plant physiology

An influential and representative deputation waited on Mr L C M S Amery Colonial Secretary, at the Colonial Office on July 7 to urge the claims of the Imperial College of Tropical Agriculture to continued Government assistance on an extended scale It comprised several members of Parliament of both Houses, eminent men of science, and representatives of the principal organisations associated with the Dominions and Colonies in Great Britain Lord Burnham, who introduced the deputation, read a letter from Mr Ramsay MacDonald expressing interest in the movement and his hopes for its success Sir Arthur Shipley then briefly reviewed the history of the College, and, referring to the financial position, pointed out that funds were urgently needed to enable the Governing Body to proceed with the erection of hostels and the provision of an estate Thus the College might be placed in a position to provide for the requirements of the students, who would be proceeding to it under the scheme prepared by the Committee of which Lord Milner has been chairman, for the training of officers for the Agricultural Departments throughout the Empire The cost of the hostel he placed at 25,000*l* and that of the estate for research work and the practical study of farming in all its branches at 25,000*l* Mr Amery in reply stated that the case of the College has already been before the Committee of Civil Research, and that he hopes now to take the matter up more definitely and directly with the Chancellor of the Exchequer with the view of seeing what financial support is possible He has, he said, the greatest faith in the future of the College, which he believes will develop into an Imperial University of Tropical Agriculture

A memorandum regarding the probable amount of monsoon rainfall in 1925 was issued early in June by Mr J H Field, Director-General of Observatories of the Meteorological Department to the Government of India The rainfall of India is affected by previous weather conditions over various parts of the earth For the Peninsula the indications from Java, the Cape, South America and Dutch Harbour are slightly unfavourable this year, but their combined effect on monsoon prospects is small For north-west India a prejudicial influence exists this year from the very large excess of rainfall in south Rhodesia, and this receives some little support from conditions at Dutch Harbour, the effect of the other factors is negligible For the Bay monsoon current the only indications as yet discovered are those from the wind and rainfall of Seychelles, the rain has been normal, but the strength of the wind is a favourable feature Monsoon rainfall would appear to be likely to be normal or in defect in the Peninsula, normal or in excess in north-east India, and in defect in north-west India

Sir Richard Redmayne, formerly chairman of the Imperial Mineral Resources Bureau, which has recently been amalgamated with the Imperial Institute, South Kensington, has been appointed director of the Imperial Institute He has accepted the appointment on the understanding that it will be for a short period only, in order that he may supervise the amalgamation of the two bodies

At the ordinary meeting of the Royal Society of Edinburgh held on July 6 the Makdougall Brisbane Prize for the period 1922–1924 was presented by the president to Prof H Stanley Allen, professor of natural philosophy in the University of St Andrews, for his investigations in theoretical physics, particularly for his communication to this Society on the magnetic character of the quantum, and on static molecular models of hydrogen and helium

The Chalmers Memorial Gold Medal was presented at the recent annual general meeting of the Royal Society of Tropical Medicine to Prof Warrington Yorke, professor of parasitology in the University of Liverpool and Liverpool School of Tropical Medicine, in recognition of his work on trypanosomiasis malaria, and other subjects The medal is awarded biennially to persons less than forty-five years of age for "researches of outstanding merit contributing to our knowledge of tropical medicine and hygiene"

M A F Dina and his wife have given the Paris Academy of Sciences a sum of a million francs, the income from which is to be devoted to the manufacture or purchase of astronomical instruments for observatories concerned with astronomy, meteorology, or geophysics, together with an astronomical library for such observatories

Prof W M Davis, emeritus professor of geology at Harvard University, and Dr G Holm, Geological Survey of Sweden, Stockholm, have been elected foreign members of the Geological Society Prof P Lemoine, professor of geology in the National Museum of Natural History, Paris, Dr V Madsen, of the Royal Library, Copenhagen, Prof P Niggli, professor of mineralogy and petrography in the University of Zurich, Prof J F Pompeckj, professor of geology in the University of Berlin, Dr T W Vaughan, of the United States Geological Survey, and Dr M D Zalessky, Leningrad, have been elected foreign correspondents

The Summer Meeting of the Royal Cornwall Polytechnic Society will be held on July 21-24 at the Polytechnic Hall, Falmouth An exhibition of Cornwall art and handicraft will be opened on July 21 by the president, the Right Hon Viscount Falmouth, who will give an address on "Recent Developments of Physical Science," which will be followed by a paper by Mr Henry Jenner on "The Holy Wells of Cornwall" Other papers to be read during the meeting are "Boulton and Watt in Cornwall," A K Hamilton-Jenkin, and "The Mining Coinage of Cornwall," E W Newton On Friday, July 24, a lecture will be given by Dr W D Prendergast on Cornwall and the ceramic industry

A medal for archæological research has been instituted, and attached to the Board of Archæology in the University of London The first presentation was made at University College, on July 7, by Prince Arthur of Connaught, to Sir Flinders Petrie in recognition of his half-century of work for archæology The medal bears Sir Flinders Petrie's bust on one side, and on the other the searching ibis, the hieroglyph of

"finding," placed before the head of Khufu, which was found by Sir Flinders In returning thanks for the presentation Sir Flinders compared the expansion of the knowledge of man by the methods of archæology, to the extension of our knowledge of the universe by spectrum analysis, two movements which had grown simultaneously within his memory

THE following are among the Civil List pensions recently granted —Miss Maria Birch, in recognition of the services rendered by her father, the late Dr Walter de Gray Birch, to the science of archæology, 100*l* , Mr J T Cunningham, in recognition of his services to zoological science and economic zoology, 100*l* , Prof Patrick Geddes, in recognition of his public and educational services, 100*l* , Mrs Amelia Sarah McLeod, in recognition of the services rendered by her husband, the late Prof Herbert McLeod, F R S , to science, 45*l* , Mrs Emily Rambaut, in recognition of the services rendered by her husband, the late Dr A A Rambaut, to astronomical science, 50*l*

FOLLOWING a highly successful conference held at High Leigh, Hoddesdon, in September 1924, of those interested in special libraries and agencies for the collection, treatment and distribution of information, a representative standing committee was appointed to ensure continuity of the work Assistance has been obtained from the Carnegie United Kingdom Trustees, and the proceedings of the first conference have just been issued The committee has decided to name the body thus called into being "The Association of Special Libraries and Information Bureaux" The second conference of the Association will be held at Balliol College, Oxford, during the week-end September 25-28 , full particulars can be obtained from the Organising Secretary at the Offices of the Association, 38 Bloomsbury Square, London, W C 1

Observation, of which we have recently received Part 3, is a periodical intended for readers of secondary school and training college age It is issued by Leplay House, London, and as might, therefore, be expected, its keynote is the cultivation of the faculties of observation in everyday life Its articles record the results of first-hand observations of peoples, activities, and places Those in the present number deal, among other matters, with Sarawak, this by Mrs Charles Hose, the Scillies and their bird life, London and its buildings, place names, wild flowers, and typical Norwegian farms The articles are well illustrated

WE have received from the Mellon Institute of Industrial Research of the University of Pittsburgh the list of publications and patents by members of the Institute during 1925 This gives evidence that the wide variety and practical utility of the subjects investigated in the Institute still continues Laundry work, refrigeration, fire-extinction, smoke-abatement, and the design of ventilators are a few of the subjects of publications or patents The subject "Jewelry from Fish Scales" recalls the famous experiment for extracting sunshine from cucumbers, to which the discovery of vitamins has given a new meaning It is evident from the list that industrial research as understood at the Mellon Institute embraces all the experimental sciences

THE April issue of the Journal of the Franklin Institute contains two interesting papers, one, by Prof Haber, on the practical results of the theoretical development of chemistry, and the other, by Prof Donnan on the influence of J Willard Gibbs on the science of physical chemistry Dr Haber commences with a consideration of the "structural" period in chemistry, a period in which dyestuff investigation was developed This was followed by the "thermodynamic' period The application of thermodynamics to solution phenomena and the advent of the electrolytic dissociation theory fall within this period In this connexion, nitrogen fixation and the use of catalysts in general are discussed The third period is that through which we are now passing, namely, one in which atomic structure is being interpreted electrically Capillary chemistry falls in this class, and the theories of adsorption are described in detail, simple explanations being given for Szyszkowski's empirical law and for Freundlich's adsorption isotherm Prof Donnan's lecture shows how firmly Gibbs laid down the foundations of thermodynamics, and an excellent account of Gibbs's method is given The phase rule is given prominence, and Prof Donnan shows throughout how much indebted are modern workers in this field to the fundamental researches of the great American physicist

WE have received from Messrs Adam Hilger, Ltd , a pamphlet entitled "Applications of X-Ray Spectrography and Crystallography to Metallurgy and to Chemical Problems," supplementary to the small volume on optical methods in research issued by the same firm The pamphlet contains useful hints on the methods and limitations of X-ray spectroscopy, followed by suggestions as to the use of this method for the solution of practical problems in metallurgy In illustration, examples are quoted from recent authors, showing how the deformation of crystalline aggregates as well as of single crystals produces characteristic changes in the X-ray pattern given by a metal, as in the work of Taylor and Elam, Polanyi, Bain, and others An excellent bibliography is appended, from which, however, we miss any reference to the work published in *Stahl und Eisen* or in the *Mitteilungen der Institut fur Eisenforschung* Work of this kind has, among other things, shown the remarkable similarity between the structure of natural fibres, such as cotton and silk, and that of cold-drawn metallic wires The mechanism of deformation of crystals is still a matter for controversy, and it seems probable that some refinement of X-ray technique will be necessary before this method can be expected to give results quite free from ambiguity The evidence already available is, however, of the highest interest, and no metallurgist who is interested in the problem can afford to disregard it

A SHORT but useful catalogue of second-hand science books has reached us from Messrs W and G Foyle,

Ltd., 121 Charing Cross Road, W.C.2. It gives particulars of nearly four hundred works dealing with zoology in general, with separate sections relating to ornithology, entomology, and botany. The list is sent free upon request.

Messrs. Dulau and Co., Ltd., 34 Margaret Street, W.1, have recently issued two useful catalogues (Nos. 129 and 130). No. 129 contains some 1300 books and papers on entomology, conveniently classified under the names of the insect orders, economic and general entomology, serial publications, and Arachnida. In No. 130 are listed upwards of 2000 works classified under the headings of ornithology, mammals and sport, reptilia, fish and fishing industries, conchology, general zoology, biology, Darwinism, evolution, heredity and Mendelism. The catalogues can be obtained free upon application to the publishers.

We have received the annual booklet issued by Messrs. Burroughs Wellcome and Co., which gives instructions and formulæ for photographing with the aid of their tabloids and Photographic Exposure Calculator. It includes the technique of desensitising, and a page of plate speeds which brings the speed tables in the Exposure Calculator up-to-date. The booklet, "Photographic Signposts" is sent post free on application to Messrs. Burroughs Wellcome and Co., Snow Hill Buildings, London, E.C.1.

Applications are invited for the following appointments, on or before the dates mentioned:—A full-time teacher for mining courses under the County Council of the West Riding of Yorkshire—The Technical Branch, County Hall, Wakefield (July 23). An assistant master to organise biological teaching in Campbell College, Belfast—The Headmaster (July 25). An assistant lecturer in mathematics in the University of Manchester—The Internal Registrar (July 31). A junior demonstrator of anatomy in the University of Birmingham—The Secretary (July 27). An assistant lecturer in engineering in the University of Manchester—The Internal Registrar (August 1). A demonstrator in physics in the University of Leeds—The Registrar (August 6). Lecturer in physiology in the University of Birmingham—The Secretary (August 24). The Dutton Memorial professorship of entomology in the University of Liverpool—The Registrar (October 1). The Ormond professorship of music in the University of Melbourne, the senior lectureship in philosophy in the University of Melbourne—The Agent-General for Victoria, Australia, Melbourne Place, Strand, W.C.2 (October 15). A full-time lecturer in mathematics at University College, Southampton—The Registrar. Lecturer on tropical hygiene at the London School of Hygiene and Tropical Medicine—The Secretary, 23 Endsleigh Gardens, N.W.1. A demonstrator in physics in the University of Toronto—Prof. J. C. McLennan, Athenæum Club, Pall Mall, S.W.1. Senior physics master at the Cowley Boys' School, St. Helens—Secretary for Education, Education Office, St. Helens.

Erratum.—In the issue of July 4, p. 22, col. 2, line 22, for "South American" read "South Italian."

Our Astronomical Column.

The Delporte Object.—M. Delporte has issued a notice of erratum in his telegram announcing the finding of this object. The figures $+1^m\ 48^s$, N. 14′ were really the motions in R.A. and Decl. in 2 days, not 1 day. Making this alteration, it was soon found that the object is not new, but is identical with the minor planet 29 Amphitrite, which is in opposition next October, some six months before its perihelion. It had already been perceived that Amphitrite was close to the position given by M. Delporte, but the original statement of its motion seemed fatal to identity.

Amphitrite is one of the brighter members of the family, and was discovered by Mr. A. Marth in London in 1854.

The Near Approach of Eros in 1931.—Dr. G. Witt, who discovered Eros in 1898, has been studying its perturbations for many years, and gives in *Astr. Nach.*, 5375, an ephemeris from October 1, 1930 (parallax 12.2″), to May 5, 1931 (parallax 16.4″). It is nearest to the earth (parallax 50.3″) on January 30, fifteen days after perihelion. Its magnitude will then be 7.1, so that it will be easily visible in a field-glass.

The declination is +44° on October 1, −3° on January 30, −22° on May 5.

The same issue of the *Astr. Nach.* contains a list of stars for comparison with Eros. Very few of them are fainter than 9.0 mag., so observations with meridian instruments are desired. Each plate of 2°×2° will contain about eight of these stars. Fainter stars will be necessary for instruments with long focus but their places can be photographically determined, using the stars of this list as a basis. The present list contains 419 stars and follows the place of Eros for October 1 to January 8. A second list will be issued for the remainder of the apparition.

Carbon Bands in Comet Tails.—M. F. Baldet has studied the effect of pressure on the band spectrum of carbon in a thermoelectronic tube (*C.R. Acad. Sci.*, Paris, April 20). He finds that at low pressures the second and third positive groups of bands and the new group recently discovered by him disappear, leaving only the third negative group, or comet tail spectrum, and the first negative (ultra-violet) group, which remain well developed. Under these conditions the emission of light is due to electronic shocks, while at higher pressures the shocks of ionised molecules with one another and with neutral atoms are concerned, giving the other band systems mentioned above. This seems to confirm Deslandres' theory of corpuscular or electronic radiation from the sun, which produces the coronal streamers and the polar aurora. So far only the negative group of nitrogen in the comet Morehouse has been ascribed to the action of this electronic radiation; but from the work of M. Baldet and others it now appears probable that the carbon bands observed in comet tails are due to the electronic bombardment of oxides of carbon at exceedingly low pressure.

Research Items

ARCHAIC SCULPTURE, GORGONA ISLAND, SOUTH AMERICA.—Mr. James Hornell, who is the official ethnologist of the *St. George* Expedition, organised by the Scientific Expeditionary Research Association, gives in *Man* for June a detailed account of the archaic sculptures which were discovered on Gorgona Island, off the coast of Colombia. These sculptures were on two groups of boulders, the majority of the older examples being below present tidal level. On many of the stones it can only be discerned that designs have existed, but on four they are comparatively well preserved. These form an ordered group around a huge, roughly quadrangular boulder bearing upon its upper surface the representations of a pair of rude ungainly human figures, male and female, each with a number of rays around the head in the shape of a halo. The figures stand side by side. The male measures 1 ft. 10 in. in height. The outlines are formed by broad shallow, rounded grooves. On another stone is a rudely sculptured stepped pyramid of four superimposed platforms, progressively decreasing in size. Six circular depressions or cups occupy the face of the third storey and the upper half of the second. This pyramid may be a representation of an early form of the Mayan and Aztec temple of the sun, the six cups representing astral deities. Of the other two boulders, each has a representation of a monkey of crude and childish design. Other sculptures, belonging to another and later group, and pottery and stone implements were also found.

AUSTRALIAN AND MELANESIAN AFFINITIES IN SOUTH AMERICA.—Dr. Paul Rivet, in a communication to the Academie des Sciences et Belles Lettres, which appears in the *Comptes rendus* covering the session 1924, discusses the evidence for concluding that certain of the peoples of Central and South America exhibit affinities to the Australians and Melanesians. Up to the present, all efforts to establish a connexion between the languages of America and of the Old World have failed except in the case of the Eskimo, whose language probably belongs to the Ural-Altaic group. Now, however, it appears that the Hoka group, comprising a great number of tribes, extending with some interruptions along the Pacific coast from the south of Oregon to Tehuantepec, shows marked similarities in vocabulary to the Melaneso-Polynesian languages. A second known as the Tson group, which includes the Patagonians and the Ona, in like manner exhibits affinities with the Australian languages. It is remarkable that those resemblances are found among the rare words which are common to the highly differentiated Australian dialects. In each case the similarities are the more noteworthy because the Australian and Melanesian vocabularies, from which the material for comparison has been taken, contain a comparatively small number of words. In 1909, ten Kate and de Quatrefages both pointed out that a Californian people and the Lagoa Santa race presented affinities in osteological characters with the hypsisteno-cephalic race of Melanesia, and this has recently been confirmed by R. Verneau, while Graebner, Nordenskiold and P. Schmidt have pointed to the remarkable similarities in South American and Melanesian material culture. In the case of the Australian, Verneau has pointed to the existence of a platy-brachycephalic type in Patagonia which is Australoid, and recently Lebzelter has described an Ona cranium in which this character is even more marked.

USES OF INTELLIGENCE TESTS.—The Bureau of Education, Washington, has issued a leaflet (City School Leaflet, No. 20), dealing with the uses of intelligence tests in 215 cities. A questionnaire was sent to all superintendents of schools in cities of 10,000 or more population with the request that they should indicate the various purposes for which they are using tests in the elementary, junior, and high schools. The replies show that group intelligence tests are chiefly used in the schools for the purpose of classifying the pupils into homogeneous groups and for supplementing the teachers' estimates of pupils' ability, and to a much less degree for vocational guidance. Individual intelligence tests are chiefly used for dealing with subnormal children and for classification purposes; standardised educational tests are used for supplementing the teachers' estimates of the pupils' ability and for comparison with other school systems. Among the other purposes are diagnosis of causes of failure, promotion, vocational guidance, establishment of classes both for subnormal and supernormal children. The three tables supply some interesting and valuable information. It is surprising to find that they are utilised for vocational guidance purposes to a relatively small extent.

"WATER SHUT-OFF" IN OILFIELDS.—Mr. F. G. Rappoport read a paper on this important subject before the Institution of Petroleum Technologists on May 5, wherein he demonstrated the necessity for close co-operation between chemist, engineer, and geologist in dealing with this problem. Little more than arbitrary methods of prevention, usually confined to a particular well, used to be adopted, with the result that though the well might temporarily benefit, it ultimately formed the means whereby water gained access to upper oil-bearing sands over a large area. Experience, however, has taught the lesson, so much so that to-day in many countries not only is there co-operation between the various operators concerned, but Government regulations also exist in order to enforce those measures essential to the control of water flow throughout the oilfields, for example, in California, Burma, Rumania, and the Dutch East Indies. From a chemical point of view the differentiation of waters associated with petroleum is a specialised analytical process which has developed greatly during the past few years; such differentiation is to some extent a means of sub-surface correlation of water sands, and hence often a key to the disposition of related oil sands. Cementation, the universal panacea for all water ills, implies chemical research on the particular cement used. The mechanical means of preventing water encroachment concern the field-engineers, who are not only responsible for the process of cementation or other method employed, but also, acting in consultation with chemist and geologist, are careful to ensure that proper and systematic casing of the well is carried out for water shut-off, as much as for lining the well, as a factor in production.

ESTONIAN OIL-SHALE INDUSTRY.—The Estonian oil-shale or "kukersite," as it is known, was first discovered by Engelhardt some 135 years ago, but its exploitation on a commercial scale only dates from 1919, after the Estonian Government had taken over the original shale mine from the Germans, following their occupation of the country in 1918. There are now two mines, one at Kohtla (open cut mining), the other at Kukruse (underground system); a third mine at Vanamoisa has lately been developed by a syndicate operating with British capital. For 1923 there was an output from the State mines of 206,000

metric tons, while 13,140 metric tons were produced in the same year by private companies Some diamond drill boring has been carried out for the purpose of testing the extent of available resources of kukersite, and the high reserve of 3800 million tons has been estimated, to this must be added the resources of unexplored areas, which brings the estimated total up to 5000 million tons Experimental distillation of the shale on a commercial scale, using a continuous producer-retort, has resulted in a throughput of about 8 tons in twenty-four hours, the yield of crude oil amounting to 20 per cent of the weight of the raw shale The ultimate composition of this oil is carbon 81 26 per cent, hydrogen 10 15 per cent, oxygen 7 26 per cent, sulphur 1 08 per cent, and nitrogen 0 25 per cent According to Mr P N Kogerman, from whose paper before the Institution of Petroleum Technologists on April 23 these facts were gathered, this oil is at present used mainly as a fuel oil, little fractionation being attempted, though steam distillation at 100° C yields a light oil suitable for motor cars, while a heavier fraction of "motor oil" for oil-engines distils over between 280-300° C The residue is a high quality "shale asphalt" The success of this experimental work has led to the erection of a large oil distillation plant, consisting of a battery of six retorts with a 200-ton shale capacity in twenty-four hours, capable of yielding 40 tons of oil per day

THE CAUSES OF GLACIAL PERIODS —Geological evidence leads to the conclusion that there has been a more or less regular series of glacial periods, alternating with warmer interglacial ones, in the history of the earth, but the theories advanced to explain their causes have been inadequate A well-known Russian meteorologist, P J Brounov, has recently put forward in *Priroda*, a periodical of the Russian Academy of Sciences, 1924, No 7-12, a theory based on astronomical and meteorological data Formation of glaciers, according to him, depends not so much on coldness of climate as on the quantities of snow falling in a certain country The main factor causing snowfalls are the ascending currents of air which are characteristic of cyclones There are two zones of cyclones in the northern hemisphere—the northern, where the cyclones have a N N E direction and bring snowfalls, and the southern, with warm, rain-bringing cyclones The two zones are separated from each other along the zone of barometric maximum, which runs around the globe between latitudes 33° and 35° The latitudinal position of this zone plays a most important part in determining the climate of the two cyclone zones Its position, however, depends to a great extent on the velocity of rotation of the earth, since this influences deviation in the direction of cyclones There is extensive astronomical evidence that the velocity of rotation of the earth undergoes fluctuations dependent on various causes These fluctuations must result in corresponding shiftings of the zone of barometric maximum, that is, in considerable changes of climatic conditions in the cyclone zones Acceleration of the velocity must result in shifting the zone of barometric maximum towards the equator, and that would mean a corresponding extension southwards of the northern zone of cold cyclones with snowfalls, on the other hand, when the rotation of the earth becomes slower, the zone of maximum is shifted northwards and warmer conditions prevail in the middle latitudes During the last glacial period, according to Prof Brounov, the zone of barometric maximum ran in Europe, roughly speaking, along the Mediterranean Sea, after that period it shifted northwards, which resulted in a relatively dry and warm period, at present the zone is apparently shifting southwards and Europe is threatened with a new glacial period

A NEW PENTAMEROID BRACHIOPOD FROM ALASKA —Mr E Kirk has published a description of Harpidium, a new pentameroid brachiopod from the Upper Silurian of south-eastern Alaska (Proc U S Nat Mus, vol 66, art 32) So far as at present known the genus is not represented elsewhere It resembles Conchidium in its general proportions, and Pentamerus in being nonplicate but Harpidium and Conchidium seem much closer genetically than either is to Pentamerus No true Pentamerus has as yet been found in faunas of the north Pacific type, but in the interior of Alaska what appears to be a Pentamerus has been met with The interior region of Alaska, however, has closer affinities with the Rocky Mountain geosyncline and the interior of America than it has with the true Pacific region The more or less complete separation of Pacific and interior faunas seems to have held up to the time of the high middle Devonian, when there appears to have been fairly free communication between the two faunal regions The author describes and figures three new species of Harpidium

UPPER AIR IN EGYPT AND THE SUDAN —The Ministry of Public Works Egypt has issued a Physical Department Paper, No 17, on "The Upper Currents of the Atmosphere in Egypt and the Sudan," by Mr L J Sutton, Director of the Meteorological Service Pilot balloon observations were commenced at the Observatory of Helwan, 25 kilometres south of Cairo in 1907, and daily ascents have been made except on Fridays, during the four years 1920–1923 Other observations were made at Wadi Halfa, Khartoum, Mongala, and Roseires on the Blue Nile The object of the paper is not only to find mean values of the wind velocity and direction at various heights but also, when possible, to associate these values with recognised types of pressure distribution at the surface, thus a study of the daily weather map will provide better assistance in anticipating the upper winds than can be obtained from mean values calculated without respect to the surface pressure Eleven different types of weather in Egypt are considered, and the accompanying pressure and winds are illustrated by the several maps covering the surrounding neighbourhood for each The frequency of occurrence for each type is given for the several months and for the year The discussion will without doubt prove very helpful for aviation, and much valuable information is given of the upper air changes for the several stations and for the different types of weather

A STUDENT'S THEODOLITE —The teaching of practical surveying is often hampered by the fact that the number of instruments available for instructional purposes is small in relation to the number of students in the class The cost of the apparatus is usually the cause of the scarcity A Student's Theodolite which has recently been placed on the market by Messrs C F Casella and Co, Ltd, 49 Parliament Street, London, S W 1, should help to overcome this difficulty The tribrach, upper horizontal plates and standards are made of seasoned mahogany The circles are of hard white celluloid, 6 inches in diameter, and engine machined to 1° The telescope, which gives a magnification of about 4 diameters, has a fixed diaphragm, and both object-glass and eye-piece can be focussed A graduated bubble and a trough compass are provided, and the instrument is mounted on a twofold tripod The accuracy obtainable is not of the same order as that of a professional model, but the instrument reproduces all the essential features of a standard

transit theodolite The outfit should prove of service not only in assisting students to obtain an acquaintance with the broad principles of survey work, but also in preparing them to use instruments with vernier or micrometer scales and other fine adjustments

THE SPECTROSCOPIC DETECTION OF ISOTOPES —In line spectra, due to electronic jumps in the atoms, the effect of isotopes is exceedingly minute, since the energy changes are governed by the amount of the nuclear charge, and the mass of the nucleus is of very little importance in determining the frequency of the emitted light In a paper in the March issue of the *Physical Review*, Dr R S Mulliken gives the results of an investigation of the band spectrum of boron monoxide, having shown in a previous paper that in the case of a compound, one of the elements of which consists of two isotopes, two similar superposed band systems are to be expected, on somewhat different scales, and with intensities proportional to the relative amounts of the two isotopes in the element The band spectra are due in part to electronic jumps but also very largely to vibrations and rotations of the molecule, in which the masses of the nuclei are of importance, and the isotopic effects are considerable Two such band systems exist in the spectrum of boron monoxide, the weaker and larger scale system being apparently due to the less abundant isotope, B^{10}, and the other to B^{11} At certain positions in the spectrum, differences of more than 40 Å U were observed between the wave-lengths of corresponding band heads The measurements agree in a remarkable manner with the theory

MEAN FREE PATH OF NEUTRAL SILVER ATOMS IN NITROGEN —Dr F Bielz describes in the *Zeitschrift fur Physik*, April 28, a series of measurements made with an apparatus similar to that previously employed by Prof Born and Fraulein Borman A stream of silver atoms passed from a chamber, which was heated in an electric oven, through a narrow tube into a space containing cool nitrogen at a low pressure, forming a narrow "beam" Three small glass plates at different distances from the entrance tube could be shifted in turn into the path of the beam by means of a magnetic arrangement, the times of exposure of the three plates being nearly equal The thin layers of silver deposited were treated with iodine vapour to convert them into silver iodide, and their thicknesses, which varied with the distance from the entrance tube, were measured, using an Abbe microspectroscope and the Wiener interference method The mean free path of the silver atoms was then calculated by means of a formula derived by the author, and it was found that the product of pressure and mean free path was constant, within the limits of experimental error, for pressures of 1 to 7×10^{-3} mm Hg The radius of the neutral silver atom calculated from this product is 1 0 Å U , values ranging from 0 57 Å U to 1 78 Å U have been found by other observers using other methods Dr Bielz states that no source of error occurs in his experiments which would make his value too low

OPTICAL PHENOMENA AND THE QUANTUM THEORY —In the April number of the *Physical Review*, Dr J C Slater puts forward a detailed theory of optical phenomena, based on suggestions already made by him in conjunction with Bohr and Kramers (*Phil Mag*, vol 47, p 785) The atoms are supposed to radiate and absorb during the stationary states, and the transitions from orbit to orbit influence radiation only by terminating the radiation characteristic of the first state and commencing that of the second The strict law of conservation of energy does not hold, since the atoms do not change their energy while radiating, though the energy in the field of radiation increases during this interval, the atomic energy changes discontinuously during the transitions There is, however, conservation of energy and of momentum, considering both the atomic energy and that of the radiation field, when an average is taken over a great number of atomic processes The new suggestion is made that resonance radiation is to be identified with the radiation of the spherical wavelets which, by their interference with the external field, also produce absorption Einstein's statement of the probabilities of the transitions of atoms is used, and the probability of interruptions of coherent vibrations is discussed Detailed descriptions of the fields emitted, which consist of spherical wavelets with the frequencies of the various quantum lines which the atom can emit or absorb in its existing stationary state, are given, and it is shown how dispersion results The assumptions made satisfy the correspondence principle, and the radiation field is essentially like that of the classical theory, which is known to agree generally with experiment The theory gives a minimum value for the breadth of emission and absorption lines, which is the same for both classes and depends on the finite life of the wave-trains, Kirchhoff's law also holds for these lines The applications of the new theory to emission of light by bombardment with electrons at the resonance potential, to resonance radiation and its quenching by foreign gases, and to absorption, scattering and dispersion are dealt with in a satisfactory manner

TOTAL HEAT OF SUPERHEATED STEAM —The electric lighting industry is looking forward to great improvements in steam generation in the boiler-house During recent years the standard working steam pressures have risen from 200 lb per sq in to 450 lb per sq in, but much higher pressures are in use The Edison Co of Boston has boilers supplying steam at a pressure of 1200 lb per sq in to a high back pressure turbo-generator The exhaust steam is reheated to 700° F, and then enters a second turbine which is of ordinary construction Engineers are contemplating even higher pressures In the June issue of *World Power*, a valuable report by Prof H L Callendar to the Electrical Research Association on the total heat of superheated steam at high pressures is published Many conflicting tables have recently been published in Germany of the total heat at saturation As a rule these have been obtained by extrapolating empirical formulæ representing small uncertain deviations at comparatively low pressures, little regard being paid to the well-known properties of fluids in the critical region In this report Prof Callendar describes a direct method of measuring the total heat which has already been applied successfully at moderate pressures and, provided the difficulty of regulating the pressure can be surmounted, there is no reason why it should not give with equal facility accurate results at the highest pressures obtainable There are many advantages in the steady flow method of calorimetry which he adopts over the more ordinary methods The difference of temperature to be measured is steady, and admits of direct observation by a single reading with a differential pair of platinum thermometers No correction has to be applied for the water-equivalent which is so great a source of uncertainty at high temperatures The flow of the fluid itself supplies sufficient stirring, and each part of the apparatus can be jacketed with its own flow A discussion is given of the effect of time-lag in evaporation of nuclear drops The primary object which the author has in view is the verification of the tables of the total heat near saturation, and his results will be of great value to the electrical industry

Southampton Meeting of the British Association

Local Arrangements

The week from Wednesday, August 26, to Wednesday, September 2, will see the British Association for the Advancement of Science at Southampton for the third time in its long history of ninety-five years. Twice in the past, in 1846 under the presidency of Sir R. I. Murchison, and also in 1882 under Dr. (afterwards Sir) Charles Siemens, has it met there, and this year will see it once again in Britain's premier passenger port under Prof. Horace Lamb, formerly of the University of Manchester. Arrangements have been made with British railways so that members of the Association attending the meeting may obtain return tickets to Southampton at the price of single fare and a third.

The Reception Room will be the King Edward VI. Grammar School, which is conveniently and centrally situated, facing the open space called the Marlands, on one side of which is the public stance for chara-bancs, while close behind it is the West Station on the main Southern Railway line from Waterloo to Weymouth, at which most of the visitors to the meeting will alight from their trains. For the convenience of the members it has been arranged with the railway authorities for a special train to be run from Waterloo on the day before the opening of the meeting (Tuesday, August 25). Within easy distance of the Grammar School are to be found the shops and restaurants of Above Bar Street, and an agreement has been reached with a firm of local caterers to take for the week of the visit the Coliseum, a hall capable of seating 1600, and run it as a restaurant at which lunches and teas may be had.

At the town end, within a short radius—half a mile at most—of the Reception Room, sections A, B, C. F, G, and M have found suitable accommodation. In the Free Library across the park from the Grammar School, C (Geology) comes nearest; opposite it, at the far corner of Brunswick Place and Dorset Street, A (Mathematics and Physics) occupies the Lamb Memorial Hall; farther up the street from the Free Library on the London Road we find in order B (Chemistry) at the Kell Hall, corner of Bellevue Road, and M (Agriculture) at the Friends' Meeting-House in Ordnance Road, immediately opposite the main entrance to the Ordnance Survey Office. In the opposite direction from the Reception Room, at the bottom of East Street, F (Economics) and G (Engineering) are housed in the new Wesleyan Central Hall, the auditorium of which will be the place of meeting for the presidential address on the evening of Wednesday, August 26, and also for the Children's and Citizens' Evening Lectures. The Royal Pier, in the pavilion of which the mayoral reception will be held on the evening of Thursday, August 27, is at a tramcar terminus not far from the south end of the High Street, which, passing northwards as Above Bar Street, London Road and the Avenue, is the principal thoroughfare of the town. About the middle of the Avenue, section H (Anthropology) is located at the Avenue Hall, attached to the Avenue Congregational Church. The ordinary tramcar service passes by or very close to all these meeting-places, the last mentioned of which, the Avenue Hall, is the most distant, being about one mile from the Reception Room.

The remaining sections, D, E, I, J, K, and L, meet at the University College, Highfield. D (Zoology) in the main corridor to the right of the south entrance on the ground floor next to the Women's Common Room; E (Geography) in the Engineering block—associated with this section is the important exhibition of maps belonging to Sir George Fordham; I (Physiology) at the opposite end of the main corridor to D on the ground floor opposite the Men's Common Room. J (Psychology) in the Library and Senior Common Room on the first floor above I. K (Botany with the subsection of Forestry) on the first floor above D; and L (Education) in the newly built Assembly Hall opposite the College Refectory, where luncheons and teas may be had. This grouping of half the sections at the University College, which is rather remotely placed from the central Reception Room and is a good ten minutes' walk from the tramcar termini at either Bassett or Portswood, has necessitated for the convenience of the members a special bus service past the College buildings to join up with the rest of the town.

The University College has put its three hostels at the disposal of the Association. The largest, South Stoneham House, a Queen Anne mansion surrounded by beautiful grounds, will house the Secretariat; the next, Highfield Hall, will accommodate some sixty members as a hostel, and in the same way South Hill, a former residence of the Bishop of Southampton, about half that number. South Hill is situated some ten minutes walk from the Bassett tramcar terminus or from the University College. Highfield Hall is on the Common, not far above the Avenue Hall; while South Stoneham, a former residence of Lord Swaythling, is at Swaythling, close to the car terminus and railway station of that name. It is fully two miles distant from the Reception Room and almost three miles from the Wesleyan Central Hall, though connected to both by electric tram service of some half an hour's duration.

Garden parties have been offered by Lord and Lady Swaythling at Townhill Park; Lord and Lady St. Cyres at Walhampton, near Lymington; and Mr. W. Collins at Westend; while the Cunard and White Star Companies, with their wonted generosity, have invited as many members as may care to go to see over one of their ships.

Southampton is remarkable for its fine open spaces, which stretch from the lower part of the town almost without break to the Southampton Common, the latter covering an area of more than 360 acres of virgin land. Its immediate environs include many places of great natural beauty. General excursions are being arranged to visit old Southampton, the Docks, New Forest, Stonehenge, and other places of interest in the neighbourhood. The full list of excursions, including sectional ones and visits to works, will be given later in detail. While tickets for the general excursions will be obtainable at a counter in the Reception Room, those for all the sectional excursions may be had from the local sectional secretaries at the various rendezvous of the sections during the week of the visit. The committee of the Royal Yacht Club has very kindly extended hospitality of honorary membership to the visiting members of the British Association.

Southampton, rich in historical associations, favoured by its geographical situation at the confluence of the rivers Itchen and Test, and unique in its modern commercial development, awaits the advent of the British Association into its midst with great interest. It is fully conscious of the honour conferred on it by such a visit, and is determined to make it the signal success which the occasion demands.

W. Rae Sherriffs.

Meteorology in the Republic of Colombia

ON the occasion of the establishment of a new observatory at Bogota, capital of Colombia, in connexion with a general reorganisation of official geophysics in the Republic, the director, the Rev S Sarasola, *S J*, is anxious that attention be directed to the first publication of the new institution (Notas Geofisicas y Meteorologicas, No 1, Bogota, 1924) This comprises a description of the new observatory, a history of previous observatories, in the work of which Baron Humboldt interested himself a century or so ago when travelling in South America, an account of the physical geography of Colombia, and a discussion of climatic, magnetic, and seismic conditions, together with copious meteorological statistics for Bogota, at an altitude of about 9000 ft on the eastern ridge of the Cordillera, and other cities

Father Sarasola desires especially to make known that neither at Bogota nor other places in this quarter of the globe does observation establish anything in the nature of a constant upper wind from the S W answering to the "anti-trade" of the text-books It appears from the data relating to upper-cloud movements which are given, not only for Colombia, but also for neighbouring countries including the West Indies, that the most prevalent direction of the upper current is S E rather than S W This, we would observe, is in conformity with the view that the real direction of the return or counter-trade in the northern hemisphere, at the equatorial limit, is S E, becoming S W towards higher latitudes (see, for example, W R Blair's paper on the planetary circulation in the *Monthly Weather Review* for April 1916) But however this may be, we are really not surprised at Father Sarasola's failure to observe a constant anti-trade over Colombia and we think that he may possibly be under some misconception as to the extent to which European meteorologists nowadays really believe in the *fixity* of the so-called trades and anti-trades The fact of the matter is that these terms though useful and proper generalisations from the facts of wind and pressure distribution as shown on mean or average charts should not be applied too rigorously to actual momentary distributions without first of all formulating a definition of what a trade or anti-trade really is Not only do the conventional trades moving round the flanks of the subtropical anticyclones shift their latitudinal limits with the seasons, but they also vary their position with changes in the day-to-day distribution of pressure, so that the task of identifying a given air-current as a "trade" would not always be possible without an exact definition which would be difficult to frame We are therefore the more convinced, from the unfruitful search in Central and South America for the *stereotyped* anti-trade of the text-books, that the terms "trades" and "anti-trades," like "westerlies" of higher latitudes should only be used in a generalised sense to denote the average trend of the circulation of the atmosphere within certain belts of latitude At the same time we are fully aware that there are certain ocean tracts where unmistakable "trades" do blow very steadily for weeks on end in a way that the highly variable "westerlies" do not

Since climate cannot be properly portrayed by statistics alone, which can never render local colour, it is pleasing to find Father Sarasola quoting a vivid description of a writer, Señor Caldas, of climatic conditions on the west coast of Colombia which, with a mean annual rainfall of about 200 in, is one of the wettest regions of the globe We render the passage from the Spanish "It rains for the greater part of the year Legions of clouds hurl themselves against the sky from the direction of the Pacific The west wind, which reigns constantly over those seas, flings the vapours on to the continent where the Andes arrest them in full career There the clouds accumulate and give the mountains a dark and menacing aspect The sky vanishes, and on all sides appear nothing but heavy black clouds threatening all living creatures An oppressive calm supervenes marking a terrible moment, then a hurricane of wind uproots immense trees, to the accompaniment of electrical explosions with dreadful crashes of thunder, the rivers leave their channels, the infuriated sea inundates the coast with gigantic waves sky and earth are confused and all seems to herald universal destruction In the midst of so much turmoil the traveller turns pale, but the native of the Choco stays quietly at home in the bosom of his family, for long experience has taught him that the results of such convulsions of Nature are seldom mournful, that it is all nothing but light water, and noise and that within a few hours equilibrium and calm will be restored"

L C W BONACINA

Chlorocruorin

THE study of the pigments occurring in Nature has shown that from both the hæmoglobin of animals and the chlorophyll of plants, substances of similar chemical constitution can be derived under the influence of appropriate reagents These bodies are known as the porphyrins and are made up of pyrrol groups but from this point the resemblance between hæmoglobin and chlorophyll ceases, since the former contains iron in its molecule, while magnesium is present in the latter also the other groups present in the respective molecules and the functions of the substances themselves are different How far the resemblance between these two pigments is significant is uncertain, since the details of the synthesis of hæmoglobin in the animal body are unknown, but it is possible that the pyrrol rings have some special property which serves as a useful basis on which to build up more complex substances with the peculiar properties of hæmoglobin and chlorophyll respectively In this event the difference in their functions will be largely due to the other constituents of their molecules

There appears to be no reason, however, why other substances derived also from the porphyrins should not be found in Nature if compounds with similar, or possibly even dissimilar, properties to hæmoglobin or chlorophyll are required in the economy of the organism An example is chlorocruorin, the green pigment in the plasma of certain polychætes (the Chlorhæmidæ and the Sabelliformia) H Munro Fox (Proc Cambridge Philosophical Society (Biological Sciences), 1924, vol 1 p 204) has recently given an account of some of the properties of this substance The specimen examined was obtained from the blood of *Spirographis Spellanzanii* and although green in colour it is related to hæmoglobin, in that the porphyrin from which it is derived is the same as, or closely allied to, hæmatoporphyrin The pigment exists in both the oxidised and reduced forms, and from it a series of derivatives can be obtained which resemble those obtained from hæmoglobin The spectra of these derivatives are in many cases very similar to those of the parallel derivatives of hæmoglobin but with the bands shifted towards

the red end of the spectrum in a few cases the resemblance between the derivatives is less close Even when the protein part of the molecule has been removed, leaving the hæmatin derivative, the two hæmatins are not the same, so that although each consists of porphyrin + iron, the method of combination must be different Further divergence occurs when the protein is added to the iron-containing part of the molecule

The chemical similarity between chlorocruorin and hæmoglobin suggests a similarity of function also Indeed the author shows that chlorocruorin can act as a respiratory pigment, in that the oxidised form can be reduced by exposure to a vacuum or by living tissues The amount of oxygen in the blood of Spirographis appears to be about one-third of that found in a similar quantity of human blood The function, however, of this pigment in the economy of the worm is uncertain, since the blood does not undergo a complete circulation Although it may not convey oxygen from the surrounding medium to the body tissues as hæmoglobin does, yet it may permit of a more active gas exchange and perhaps, at times, make the worm less dependent on the oxygen in the surrounding water Chlorocruorin thus appears to be "a unique case of the parallel evolution of a substance resembling hæmoglobin"

University and Educational Intelligence

ABERDEEN —Applications are invited from graduates of the University of Aberdeen for the Wilson Travelling Fellowship, which is for archæological and anthropological research in the near East, including the Balkan Peninsula, Asia Minor, Palestine, Egypt and Mesopotamia The fellowship is of the annual value of 300*l*, with a possible increase, and is tenable for two years Applications must be received before August 1 by Mr A Martineau, 1 Golden Square, Aberdeen

BELFAST —At the Summer Graduation Ceremony of the Queen's University, held on Friday, July 10, Prof F G Donnan of University College, London, received the degree of D Sc *honoris causa* After a very distinguished career as an undergraduate of Queen's College, Belfast, Prof Donnan obtained his degree with the highest honours in the late Royal University and as professor of chemistry in the University of Liverpool and in University College, London, he has done work which has gained for him a foremost position amongst chemists The degree of D Sc *honoris causa* was also conferred upon Prof E W MacBride, professor of zoology of the Imperial College of Science and Technology, London Prof MacBride was a student and scholar of Queen's College, Belfast He entered St John s College, Cambridge, of which he became a fellow, and he also graduated with the highest honours in the University of London His work as a zoologist at McGill University, Montreal, and the Imperial College, London, is well known

BIRMINGHAM —Sir Oliver Lodge has been appointed Huxley lecturer for session 1925–26, the subject of his lecture being "Difficulties of the Ether"

Dr G F Still has been appointed Ingleby lecturer for 1926, and Dr Leonard G Parsons for 1927

Prof Leonard Gamgee has presented to the University a sum sufficient to provide a gold medal to be awarded annually to the candidate who passes the summer final examination for the M B, Ch B degree and who gains the highest marks for surgery The medal is to be called the Sampson Gamgee medal and is in memory of Prof Gamgee's father, who worked for many years in the Birmingham Medical School

Prof T. Turner has been elected Dean of the faculty of science in succession to Prof F W Burstall, his term of office beginning on September 1

At the recent degree congregation there were conferred, among others, the following degrees —D Sc, 3, Ph D, 5, M Sc, 11, B Sc with Honours, 80, B Sc (Ordinary), 58

EDINBURGH —Prof Shield Nicholson has resigned the chair of political economy, to which he was appointed in 1880

The University Court at its meeting on June 15 approved the terms of an ordinance for the foundation of the Abercromby chair of archæology

The resignation of Mr J F Rees, reader in economic history, was received and was accepted with regret The University Court congratulated Mr Rees on his appointment to the chair of commerce in the University of Birmingham, recently vacated by Sir William Ashley

Intimation was received of a legacy by Miss Catherine S Howden of 5000*l* to found a scholarship for research work, preferably in the domain of nervous diseases, and of a gift of 50*l* by Mrs John Harrison, to be applied in assisting the printing of research papers by members of the University

Dr J M Woodburn Morison of Manchester has taken up the duties of lecturer in electrical therapeutics and radiology, which is part of a new course in clinical pathology

LONDON —Prof E A Gardner has been re-elected Vice-Chancellor for the year 1925–26

The title of professor of mycology in the University has been conferred on Mr E S Salmon in respect of the post held by him at the South-Eastern Agricultural College The title of reader in mycology in the University was conferred on Mr Salmon in 1912, and since that date he has published numerous papers on fungous diseases of plants and on fungicides

The title of emeritus professor of hygiene and public health in the University has been conferred on Sir William J R Simpson, as from the end of the present session, on his retirement from King's College, after twenty-seven years' service, on the closing of the Department of Bacteriology and Public Health

ST ANDREWS —M Étienne Gilson, Professor of the Philosophy of the Middle Ages at the Sorbonne, Paris, has just published a text of Rene Descartes' "Discours de la Methode" with a commentary The volume is dedicated to the University of St Andrews, which has recently bestowed the degree of LL D upon M Gilson

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We learn from *Science* that Mr G E Merrick has given 160 acres of land and a sum of 5,000,000 dollars towards the establishment of a university in Miami, Florida The university, which was granted a charter on April 5, will be non-sectarian and co-educational

APPLICATIONS are invited by the Royal College of Physicians for the Streatfeild Research Scholarship in medicine and surgery, the annual value of which will probably be 250*l* and the tenure three years Applications must reach the Registrar of the College, Pall Mall East, S W 1, not later than October 1

THE Dickinson Travelling Research Scholarship in medicine, which is open to students of the University and Infirmary, Manchester, has been awarded by the Trustees of the Manchester Royal Infirmary to Dr Raymond Williamson and to Mr Leslie J Witts

THE London School of Hygiene and Tropical Medicine is prepared to consider from qualified medical practitioners applications for four research

studentships in tropical medicine and hygiene The studentships are each of the value of 250*l* yearly and will normally be for two years The latest date for the receipt of applications, which should be sent to the Secretary of the School, 23 Endsleigh Gardens, N W 1, is August 31

APPLICATIONS are invited by the council of the University College of the South-West of England, Exeter, for the Andrews Simons research studentship, value 120*l*, for the furtherance of experimental research in physics, chemistry, or other branch of science The applications must be received by the Registrar not later than August 1

THE Royal Commissioners for the Exhibition of 1851 have made the following appointments to Senior Studentships and Overseas Scholarships for 1925 — *Senior Studentships* Mr O M B Bulman, Imperial College of Science and Technology (Geology), Mr P A M Dirac, Cambridge (Mathematical physics), Mr I R McHaffie, University College, London (Physical chemistry), Mr H W B Skinner, Cambridge (Physics), and Mr D L Thomson, University of Aberdeen (Bio-chemistry) *Overseas Scholarships* Mr C L Huskins, Alberta (Cytology) Mr A R Fee, British Columbia (Biology), Mr C S Hanes, Toronto (Biology), Mr J G Wood Adelaide (Botany), Mr V M Trikojus, Sydney (Organic chemistry) Mr S W Watson, South Africa (Physics), Mr R S Allan New Zealand (Geology) and Mr J J Lennon, University College, Dublin (Organic chemistry)

THE Ramsay Memorial Fellowships for chemical research are administered under a scheme framed on an international basis, the participating countries being Great Britain and Ireland, Canada, Denmark, France, Greece Italy, Japan, the Netherlands, Norway, Spain, Sweden, and Switzerland The fellowships, sixteen in number, are tenable in any university or other place in the United Kingdom possessed of the requisite facilities for research In a speech made in response to the toast of the trustees of the Ramsay Memorial Fellowships proposed by Sir William Bragg at a dinner given at University College, London, on July 3, Sir Robert Hadfield expressed the opinion that the bringing into our midst of young chemists selected from other countries to undertake research work has been a great success in promoting friendly relations and mutual understanding between men of science of different countries He quoted with approval a suggestion made by a former fellowship holder, Prof Henri Weiss of the University of Strasbourg, that the fellowships should be extended and young British skilled research workers should be sent to foreign universities This theme—the rôle of the *savant* abroad as not only purveyor of light but as promoter of peace and goodwill—is one on which quite a number of public pronouncements have been made in Great Britain during the past six months by eminent men of science, and it was discussed at length at the annual conference of the Universities of Great Britain and Ireland on May 9 In the United States likewise it has been much discussed and large sums of money have been appropriated to translating aspirations into actualities, such as the John Simon Guggenheim Memorial Foundation, to which a " preliminary " gift of 3 million dollars has been made, to provide annually from forty to fifty fellowships for ' advanced study abroad " The American Council on Education has published in the *Educational Record* for April a list of seventy-six organisations interested in such relations, and proposes to invite them all to a conference to be held at Washington in the autumn

Early Science at Oxford

July 21, 1685 Mr President being in the Chair acquainted the Society that in Northamptonshire about two or three miles from Astrop, there is dug a heavy black earth, which being calcined comes to a black sand, some of which he was pleased to shew us, almost as heavy as ye earth A Magnet being applied to this sand, was seen to attract it

A letter of Mr Leewenhoeck s concerning ye Generation of man &c from an insect was read

Dr Bernard presented some papers of Mr Greaves giving an account of some experiments made at Woolwich in ye year 1651 for ye triall of great guns —The Doctor also presented ye Society with a *Cornu Ammonis*, some *Belemnites*, *Lignum fossile*, *Ostracites*, all which were dug out of a well on a hill near Faringdon

A Letter from Mr Aston dated July 15 was read, it affirmes ye true Zaffer is nothing but Kobalt calcined, ye comon Zaffer being adulterated with pebbles

Dr Plot presented a Persian wood, which was observed to sink in water, and a Hen's egge sent him from out of Yorkshire, having a round hole at one end of about half an inch diameter this hole was exactly fitted by a little cap of ye same matter with ye rest of ye shell, but more protuberant, than ye end of an Egg-shell is naturally, and full of wrinkles the Cap is said not to have been continued to ye main body of ye shell, but sticking close by its inner side to ye membrane, was by these meanes kept as a cover on ye hole

A letter from Mr Cole of Bristoll dated July 16th, was communicated by Dr Plot and read

July 22, 1684 Two Letters from Mr Aston, one dated July ye 10, ye other 17, were read An Abstract of a Letter from Dr Huntingdon sayes, that Mr Tennant, a gentleman in Ireland, has lately invented an Engin for ye throwing of water, far exceeding that of Sir Samuel Moreland

Some of ye curiosities lately presented to ye University by Mr Cole of Bristol, were communicated to ye Society by Dr Plot, as first, Sal Gemmæ from St John de Port Rico, one of ye Leeward Islands near Jamaica It breaks generally into squares is transparent near four inches thick, so that at that thickness ye motion of a finger, playing up and down, may easily be discerned Secondly, Silk Grass of three yards long found in ye swomps, or moorish grounds, in Virginia, growing upon a tall plant from which it is strip't like Hemp Thirdly Neopolitan black writing sand, which applyed to ye Magnet in great quantitys, and much more readily than ye *ferrum Noricum*, or any other ore we have yet seen Some of this sand being calcined by Dr Plot ran into a mass, which, when cold, was very brittle Other experiments will be tried on this sand by ye Doctor, of which we are promised an account

Mr Conningham affirms, that Sal Gemmæ is commonly thrown up by ye Lammas floods within six miles of St Andrews and used by ye poor people instead of common salt

A letter from Mr Flamsteed to Mr Caswell, concerning ye late eclipse of ye Sun and ye *Maculæ Solis* observed by him, was read This great Astronomer does, in this letter, seem to question, whither these spots, seen by him, were not two differing spots rather than revolutions of ye same spot, altho ye manner of their course along ye disc of ye Sun, seems to be much alike, and therefore argues ye latter

Societies and Academies

LONDON

Royal Meteorological Society, May 20.—F. W. **Harmer** and C. E. P. **Brooks**: Further remarks on the meteorological conditions of the Pleistocene epoch. The chief difference between the North Atlantic and North Pacific Oceans is that the former is open to the north, while the latter is practically closed to the north. Hence in the Atlantic the Gulf Stream travels north-eastward into the Arctic Ocean, while in the Pacific the Japan current is forced to turn south-eastward along the coast of America. This difference causes differences in the pressure distribution; both oceanic and atmospheric circulation combine to give western Europe a more genial climate than the west of North America. The closing of the Greenland-Europe channel would bring about changes in the oceanic and atmospheric circulations which would suffice to cause a glacial epoch in Europe. The diversion of the storm tracks and the consequent alteration in the direction of the prevalent winds are probably even more important than the changes in the currents. The second part of the paper deals with the climatic changes in the Mediterranean region during the glacial period; the crowding together of the isotherms in southern Europe caused a great increase of storminess there, to which was due the torrential rains of which we have evidence.—Sir Gilbert T. **Walker**: On periodicity. Proposals that have been made in recent years for modifying Schuster's periodogram; a new criterion for the reality of a period, with some applications to meteorological data, is given.—Harold **Jeffreys**: On fluid motions produced by differences of temperature and humidity. It has been shown that the maintenance of a difference of temperature between parts of the same level surface in a fluid will necessarily maintain a permanent motion of the fluid, and that heating or cooling a fluid at an internal boundary will also maintain a permanent movement. A corresponding theorem is true for the supply of new constituents instead of heat. This result appears to contradict a theorem given by Sandstrom and Bjerknes, to the effect that a permanent motion is possible only if the place where the heat is supplied is at a lower level than that where it is removed; but the arguments of these authors involve an unstated assumption, which seems to be untrue. Sandstrom's experiment, in which no motion was observed in a tank under conditions suited to the production of a circulation, is capable of a dynamical explanation based on the slowness of conduction and the consequent confinement of the currents to narrow regions where they would be very difficult to observe. It appears unlikely that it will often be possible to proceed by analogy from this experiment to the dynamics of wind; for radiation and turbulence will always redistribute the heat in such a way as to produce general currents; but there may be some applications to ocean currents.—A. H. R. **Goldie**: Gustiness of wind in particular cases. Deals particularly with examples from the anemograph records of Falmouth Observatory during periods of S.W. wind. It was found that the time interval of the rise and fall of the anemograph pen and of the breaking of the waves on the shore approximated to seven seconds. A further investigation at Lerwick showed that the normal relation between "range of gusts" and "hourly mean wind," in the case of equatorial currents, is about one-third and nearly independent of velocity.

SHEFFIELD

Society of Glass Technology, May 25 and 26.—W. E. S. **Turner**: The nature and constitution of glass. The abnormal properties recently observed in glass when heated in the annealing range (such as greatly increased thermal expansion, heat absorption, and modification of specific electrical conductivity; and the changes of density and refractive index on heat treating glass) have their counterpart in the changes of plasticity which glass exhibits when remelted or when the raw materials have considerable quantities of moisture or of certain salts present. Two fundamental factors are involved; molecular complexity and the presence of compounds in glasses.—G. **Tammann**: On glasses as supercooled liquids. A discussion of the influence of degree of undercooling, nucleus number, viscosity and other factors on the production of the glassy state. The customary soda-lime-silica glasses may be regarded as ternary mixtures of Na_2SiO_3, $CaSiO_3$ and SiO_2. The two components Na_2SiO_3 and $CaSiO_3$ crystallise readily, as do their mixtures, from which mixed crystals separate. With an excess of silica the nucleus number of these mixed crystals is reduced extraordinarily, so that mixtures with an excess of 8 per cent. of silica or more solidify as glasses.—A. Q. **Tool** and E. E. **Hill**: On the constitution and density of glass. A glass is intermediate between the liquid and solid states. Its condition at ordinary temperatures may be considered as undercooled, not alone with regard to the process of crystallisation, usually known as the true solidification, but also with respect to the completion of many processes normal to the vitreous condition. The maximum density change observed was 1:10.—G. W. **Morey** and N. L. **Bowen**: The ternary system sodium metasilicate-calcium metasilicate-silica. The following new compounds have been found and their properties determined. The compound $2Na_2O.CaO.3SiO_2$, which melts incongruently, forming a liquid richer in Na_2SiO_3 and $Na_2O, 2CaO, 3SiO_2$; the compound $Na_2O, 2CaO, 3SiO_2$, which has a congruent melting point at 1284°; and the compound $Na_2O, 3CaO, 6SiO_2$, which melts incongruently at 1045°, forming a mixture of wollastonite and a glass containing approximately 15 per cent. CaO, 67 per cent. SiO_2.—R. W. G. **Wyckoff** and G. W. **Morey**: X-ray diffraction measurements on some soda-lime-silica glasses. (A preliminary note.) In some instances the broad bands thought to be characteristic of glasses have been found. In others narrow bands or lines have been obtained which are as sharp as the lines produced by crystals of colloidal dimensions.—Sir W. H. **Bragg**: The structure of quartz. Quartz changes its structure on passing through 575°. The high-temperature quartz is more symmetrical than the low, but the change is not severe. The four unknown quantities in low-temperature quartz reduce to one on passing to the high-temperature form: the silicon atoms are fixed, and the oxygen atoms must lie on certain straight lines. Attempts to fix the positions of the oxygen atoms can be made, based on intensity measurements. The most probable value shows, somewhat unexpectedly, that each silicon atom is at the centre of a regular tetrahedron of which the four corners are occupied by oxygen atoms. Assuming that the low-temperature quartz is not very different from the high-temperature quartz, the various twinnings of quartz are readily accounted for.—Vaughan H. **Stott**: The viscosity of glass. Final relations between viscosity and composition, in which errors due to impurities or inaccurate compositions generally are not considerably greater than the errors of the viscosity determinations

themselves, cannot be obtained unless the glasses are prepared from materials of known purity and melted without contamination This at present precludes the melting of large pieces of glass, and limits the design of viscosimeters

PARIS

Academy of Sciences, June 15—The president announced the deaths of Louis Gentil and Dr Depage—A **Haller** and Rene **Lucas** The rotatory powers of certain derivatives of camphor Seven derivatives of camphor were studied The specific rotatory powers were measured for seven wavelengths ($\gamma=6708$ to 4358) in four solvents (alcohol, benzene, carbon disulphide, cyclohexane) The rotatory power varied considerably with the solvent—J **Costantin** An old asymbiotic culture at the *Muséum*—Louis **Lumiere** Concerning the invention of the kinematograph A claim for priority—J **Haag** The probability in a circle—Bertrand **Gambier** Surfaces of which a finite or infinite number of asymptotics belong to a linear complex—Maurice **Frechet** Abstract point transformations—N **Lusin** The properties of projective ensembles—P J **Myrberg** Automorph functions—B **Galerkin** The tensions of a prism having a rectangular isosceles triangle as base—Paul **Woog** Measurements of oily friction Data are given for various oils, either alone or with the addition of fatty acids—Andre **Metz** A relativist definition of simultaneity—T **Peczalski** and G **Mokrzycki** Study of chemical compounds of salts in the electric arc The distance between the electrodes of the arc and the intensity of the current were kept constant Mixtures of oxides were placed in a crater on the positive electrode and the fall of potential measured The curve obtained by plotting composition of the salt mixture against the volts indicated the formation of compounds—N **Pariselle** Contribution to the study of the rotatory power and dispersion in the terpene series—N **Pauthenier** The rotating arc between carbon electrodes—Marcel **Peschard** The magnetisation of ferro-nickel saturations and atomic moments—Jean Jacques **Trillat** Study of soaps and fats by means of the X-rays—A **Boutaric** and Mme Y **Maniere** The influence of very small quantities of foreign substances on the stability of colloidal solutions The addition of a small quantity of an electrolyte to a colloidal suspension may protect the solution against the flocculating action of an electrolyte, may accelerate the flocculation, or may be without effect The results of experiments with two different electrolytes on a colloidal solution of sulphide of arsenic are given in the form of a table—A **Damiens** An artificial magnesium silicate—V **Auger** and T **Karantassis** Researches on the complexes of stannic iodide The compounds Rb_2SnI_6, Cs_2SnI_6, and $[As(CH_3)_4]_2SnI_6$ have been isolated—P **Lebeau** and P **Marmasse** The estimation of carbon dioxide and carbon monoxide The carbon dioxide is removed by cooling with liquid air, which at the same time removes higher homologues of methane, ethylene, acetylene and other gases likely to interfere with the iodine pentoxide reaction The gas is then passed over iodine pentoxide at 150° C and the carbon dioxide resulting from the oxidation of the monoxide again removed at −190° C The method has been applied to the determination of carbon monoxide in commercial hydrogen and also to the search for carbon monoxide in gases from borings at Pechelbronn the results in the last-named gases were negative Air gave traces of carbon monoxide (less than 5 parts per million)—Paul **Pascal** New complexes of iron derived from the triazines—Charles **Prevost** Methylphenylbutadiine—P **Gaubert** The spherolites of reamurite—Louis **Longchambon** The polymorphic transformations of silica—Jacques de **Lapparent** The relations between the hydrocarbons and carbonates in silex and the phtanites—Maurice **Jean** The nature of the internal liber of the seedling of *Convolvulus tricolor*—A **Tronchet** Polycotyly and schizocotyly in *Dimorphotheca pluvialis*—M **Bridel** and P **Picard** The preparation and properties of monotropitoside 60 grams of this glucoside have been extracted from 20 kilograms of bark of *Betula lenta* Full details of its physical and chemical properties are given It furnishes methyl salicylate, glucose, and xylose on hydrolysis—Rene **Jeannel** The homologies of the articulations of the leg in insects—Stephane **Dombrowski** The permanent regimes of concentration in a convection current and its application to physiology—Alphonse **Labbe** The curves of growth of *Artemia arietina*

ROME

Royal Academy of the Lincei, April 4—Leonida **Tonelli** Problem of primitive functions—Gabriella Armellini **Conti** Observations of the position of the planet Uranus on the occasion of its conjugation with 96 Aquarii—O M **Corbino** and E **Persico** Secondary oscillations in a generator with a three-electrode lamp—A L **Herrera** Photomicrographs showing karyokinesis figures in metaformaldehyde crystals—F **Sbrana** Characteristic property of polyharmonic functions and solutions of the equation of vibrating membranes—Umberto **Crudeli** Rutherford-Bohr triangular systems in relative equilibrium—D J **Struik** Irrotational waves in channels—G **Ponte** Vulcanological investigations Vulcanism causes a gradual impoverishment on the earth, not only of atmospheric oxygen but also of water vapour, similar to that which seems to have taken place with greater intensity on the moon—E **Adinolfi** Influence of X-rays on the crystallisation of bismuth X-rays exert on bismuth, during its crystallisation, an effect similar to, but distinct from, that caused by impurities, and varying with the hardness of the rays used—Enrico **Fermi** Relation between the constants of the infra-red bands of triatomic molecules For these molecules, the three atoms of which must lie in one plane, the expression

$$\frac{1}{\Delta\nu_1}=\frac{1}{\Delta\nu_2}+\frac{1}{\Delta\nu_3}$$

is deduced for the relationship between the constant frequency differences of the lines in the infra-red band The only triatomic molecule for which the necessary data are available is that of water vapour, and in this case the above equation holds within the limits of experimental error—U **Sborgi** Electronic theory of the anodic behaviour of metals, especially of those exhibiting passivity phenomena—G **Malquori** Mixed silver-copper basic salts Investigation of the system $Cu(OH)_2-AgNO_3-H_2O$ indicates the existence of only one mixed basic salt, which has the composition $3Cu(OH)_2, 2AgNO_3, 3H_2O$, and is stable in the presence of silver nitrate solution of concentration not lower than 0 78 per cent—Luigi **Settimj** Transformation of nitrogen compounds (proteins) in preserved food produce In food materials, whether tinned or in contact with the air, the insoluble nitrogen compounds undergo gradual transformation with production of an equivalent quantity of soluble nitrogen compounds—P **Pasquini** Further considerations on the formation of the pecten in the development of the eye of *Gallus domesticus* The evolution of the pecten in the development of the fowl's eye consists in a gradual lamination of the original pecten with consequent increase in its height in the vitreous humour, further, the lamina develops longitudinal folds which increase its surface of contact with the vitreous body—Umberto **D'Ancona** Nerve endings in the somatic muscles of the decapod crustaceans

Official Publications Received

Annales de l Observatoire Royal de Belgique Troisième Série, Tome 2 Fascicule 1 Publie par P Stroobant Pp 74 (Tournai Imprimerie des Etablissements Casterman S A)

Studies from the Plant Physiological Laboratory of Charles University Prague Edited by Prof Dr B Nemec Vol 2, 1924 Pp 106+5 plates (Prague)

Carnegie Institution of Washington Eugenics Record Office Bulletin No 24 Body Build, its Development and Inheritance By C B Davenport Pp 42 (Cold Spring Harbor, Long Island, N Y)

City and County of Kingston upon Hull, the Third Port of the United Kingdom By T Sheppard (British Empire Exhibition Wembley, 1925 Hull Civic Fortnight July 7th to 20th) Pp 40+10 plates (Hull)

Memoirs of the National Academy of Sciences Vol 20 The American Oaks By William Trelease Pp v+255+420 plates (Washington Government Printing Office) 3 25 dollars

Statens Meteorologisk Hydrografiska Anstalt Arsbok, 6, 1924 2 Nederborden i Sverige Pp 159 (Stockholm) 5 kr

Annals of the (Mededelingen van het) Transvaal Museum Vol 11, Part 2, containing Native Dolls in the Transvaal Museum, by A Radcliffe Brown 1 Initiation of Girls in the Masiyeni District, Portuguese East Africa, 2 Note on the Decorations on Carved Wooden Food Bowls from South Chopiland, Portuguese East Africa, 3 On some Ritual Objects of the Vandau in South Chopiland, Gaza, Portuguese East Africa, by E Dora Earthy, On the Development of the "Epipubis of *Xenopus*, by Dr C G S de Villiers Pp 99 135+plates 9 26 (Cambridge Printed at the University Press)

Department of the Interior U S Geological Survey Bulletin 751 Contributions to Economic Geology (Short Papers and Preliminary Reports) 1923-24 Part 2 Mineral Fuels Pp vi+321 326 Bulletin 760 C Erosion by Solution and Fill By Willis T Lee (Contributions to the Geography of the United States 1923-24) Pp ii+107 121+plates 23 30 Bulletin 780 A The Melrose Phosphate Field Montana By R W Richards and J T Pardee (Contributions to Economic Geology, 1925, Part 1) Pp iv+32+2 plates Water Supply Paper 520 F Temperature of Water available for Industrial Use in the United States By W D Collins (Contributions to the Hydrology of the United States, 1923-1924) Pp ii+97 104+plates 8 11 Water Supply Paper 520 G Some Floods in the Rocky Mountain Region By Robert Follansbee and Paul V Hodges (Contributions to the Hydrology of the United States 1923-1924) Pp ii+105 129+iv Water Supply Paper 523 Surface Water Supply of the United States, 1921 Part 3 Ohio River Basin Pp vi+316+2 plates 30 cents Water Supply Paper 531 Surface Water Supply of the United States, 1921 Part 11 Pacific Slope Basins in California Pp vii+304+2 plates 25 cents Water Supply Paper 536 Surface Water Supply of the New Kanawha River Basin, West Virginia, Virginia and North Carolina Pp iv+282+2 plates 35 cents Water Supply Paper 539 Geology and Ground Water Resources of Townsend Valley, Montana By J T Pardee Pp iv+61+2 plates 15 cents (Washington Government Printing Office)

Spisy vydávané Přírodovědeckou Fakultou Masarykovy University (Publications de la Faculte des Sciences de l Universite Masaryk) Čís 47 System vodních toku na základe odtoku (Le systeme des eaux courantes d apres leur debit d eau) Napsal Dr Fr Koláček Pp 97 Čís 48 Bromonovakain (La brome novocaine) Napsali J Frelka a J Vitha Pp 22 Čís 49 On the Growing Reactions, produced by the Change of Hydrogen Ion Concentration in Germinating Roots of *Pharbitis hispida* Choisy By Ferd Herčík Pp 21 Čís 50 Sur les probabilites geometriques Par B Hostinský Pp 26 Čís 51 Vyklad vzniku kratkých elektromagnetických vln v elektronovych lampach (An Explanation of the Origin of Short Electromagnetic Waves in Valves) Napsal Dr Josef Sahánek Pp 28 Čís 53 La valeur osmotique et la reaction actuelle de l eau du Golfe de Villefranche A quel point sont elles constantes? Par Vladimír Moravek Pp 11 Čís 54 Studie o inteligenci kočky, 2 (Studies on the Intelligence of the Cat, 2) Napsal Dr Vladimír Teyrovský Pp 48 (Brno)

British Museum (Natural History) Famous Naturalists Series No 1 Set H 2 10 post cards in monochrome (London British Museum (Natural History)) 1*s*

Bulletin of the American Museum of Natural History Vol 52 Art 2 Scientific Results of the Expedition to the Gulf of California in Charge of C H Townsend, by the U S Fisheries Steamship *Albatross* in 1911 15 The Amphipoda collected by the United States Fisheries Steamer *Albatross* in 1911, chiefly in the Gulf of California By Clarence R Shoemaker Pp 21 61 (New York)

The Iwata Institute of Plant Biochemistry Publication No 1 Untersuchungen uber den Japanlack Von Prof Rikō Majima Pp x+154+3 Tafeln (Tokyo) 2 50 dollars

Scientific Papers of the Institute of Physical and Chemical Research Nos 24 25 X ray Analysis of the Solid Solutions of Potassium Chloride and Potassium Bromide, by T Sasahara X ray Analysis of Electrolytic Brass, by H Nakamura Pp 277 292 35 sen No 26 On the Mercury Line 2270A ($1S\ 2p_1$) By T Takamine and M Fukuda Pp 293 298 25 sen No 27 Condensation of Nitriles with Thiamides 4 Thiamide with Aniliminochlorides By S Ishikawa Pp 299 304 25 sen (Tokyo Komagome Hongo)

Meddelelser fra Kommissionen for Havundersøgelser Serie Fiskeri, Bind 7, Nr 7 On the Fishery of the Greenlanders By Ad S Jensen Pp 39 3 kr Serie Fiskeri, Bind 7, Nr 8 On the Influence of the Currents upon the Frequency of the Mackerel in the Kattegat and adjacent parts of the Skagerak By Dr A C Johansen Pp 26 (København C A Reitzel)

New South Wales Department of Mines Geological Survey Mineral Resources No 33 The Gypsum Deposits of New South Wales By Leo J Jones Pp 45+14 plates 2*s* 6*d* Bulletin No 13 Chromium, Cobalt, Nickel, Zirconium, Titanium, Thorium, Cerium By H G Raggatt Pp 17 1*s* Bulletin No 14 Asbestos, Emery, Fluorspar, Fuller s Earth, Graphite Phosphates Talc and Soapstone By H G Raggatt Pp 31 1*s* Bulletin No 15 Diatomite Siliceous Earths and Sands By E J Kenny Pp 18 1*s* (Sydney Alfred James Kent)

Lady Minto s Indian Nursing Association Report for 1924 Pp 167 (Simla)

Year Book of the Department of Agriculture Ceylon, 1925 Pp ii+52 +8 plates (Peradeniya Ceylon)

University of Illinois Engineering Experiment Station Bulletin No 147 Investigation of Antennae by Means of Models By Prof J Tykocinski Tykociner Pp 60 (Urbana, Ill) 35 cents

New York Zoological Society Report of the Director of the Aquarium (Reprinted from the Twenty ninth Annual Report of the New York Zoological Society) Pp 15 (New York)

The Scientific Proceedings of the Royal Dublin Society Vol 18, N S Nos 5 9 5 The Interpretation of certain Empirical Standards in their Application to Irish Butter, by George Brownlee, 6 The Theory of Variation of Flow in Pipe lines with Surge Chambers consequent on Variation of Load on Hydraulic Turbines operated Therefrom, by H H Jeffcott, 7 The Variations in the Quantity of Food required by Cattle for Maintenance and Fat Production with different Kinds of Rations, by James Wilson, 8 The Identity of Vitamin A The Comparative Effects of Human and Cow s Milk by Harold Pringle, 9 On the Photo electric Measurement of Submarine Illumination by H H Poole Pp 49 115 (Dublin Royal Dublin Society, London Williams and Norgate, Ltd) 5*s*

Report of the Fourth International Seed Testing Congress Compte rendu du 4me Congres international d essais de semences Bericht uber den IV Internationalen Kongress fur Samenprufung in/i Cambridge England) 7 12 VII 1924 Pp 227 (London H M Stationery Office) 11*s* 6*d* net

Diary of Societies

SATURDAY JULY 18

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (at Town Hall, Folkestone), at 11 A M —A E Nichols Municipal Works at Folkestone —E C Fawcett Folkestone s New Sea Outfall Works

BIOCHEMICAL SOCIETY (jointly with the Agricultural Education Association) (at University College, Reading), at 5 —Prof R H A Plimmer The Action of Nitrous Acid upon Amides and some Amino Compounds —W J N Burch Some Esters of Phosphoric Acid —Mattick and Wright The Influence of Administration of certain Salts on the Inorganic Constituents of Milk —E Ponder and W W Taylor The Conductivity of Cell suspensions —G D Thacker and J R Marrack The State of Calcium in Body Fluids

MONDAY, JULY 20

ROYAL SANITARY INSTITUTE (at Edinburgh) at 5 —Sir John Gilmour, Bart Inaugural Address

TUESDAY JULY 21

ROYAL SANITARY INSTITUTE (at Edinburgh), at 10 A M —Meetings of Sections and Conferences Sanitary Science, Industrial Hygiene, Engineers and Surveyors Sanitary Inspectors —At 8 P M —Sir Leslie Mackenzie The Problem of Psycho physical Fitness (Lecture)

BRITISH MEDICAL ASSOCIATION (Annual Meeting) (at Bath)

WEDNESDAY JULY 22

ROYAL SANITARY INSTITUTE (at Edinburgh), at 10 A M —Meetings of Sections and Conferences Sanitary Science, Personal and Domestic Hygiene Representatives of Sanitary Authorities, Medical Officers of Health

BRITISH MEDICAL ASSOCIATION (Annual Meeting) (at Bath)

THURSDAY, JULY 23

ROYAL SANITARY INSTITUTE (at Edinburgh) at 10 A M —Meetings of Sections and Conferences Engineering and Architecture Maternity and Child Welfare (including School Hygiene) Port Sanitary Authorities, Veterinary Inspectors, Health Workers —At 8 P M —Dr C Porter The Citizen and the Citizen s Health (Popular Lecture)

BRITISH MEDICAL ASSOCIATION (Annual Meeting) (at Bath)

FRIDAY JULY 24

ROYAL SANITARY INSTITUTE (at Edinburgh), at 10 A M —Meetings of Sections and Conferences Engineering and Architecture, Maternity and Child Welfare (including School Hygiene), Veterinary Inspectors, Health Visitors

ROYAL ASTRONOMICAL SOCIETY at 4 30 —Special General Meeting

ARISTOTELIAN SOCIETY, MIND ASSOCIATION, AND OXFORD PHILOSOPHICAL SOCIETY (Joint Session) (at Balliol College Oxford) at 5 —Annual General Meeting of the Mind Association —At 8 30 —Prof H Wildon Carr, Prof A Wolf, and Prof C Spearman Symposium The Nature of Intelligence

BRITISH MEDICAL ASSOCIATION (Annual Meeting) (at Bath)

SATURDAY, JULY 25

ARISTOTELIAN SOCIETY, MIND ASSOCIATION, AND OXFORD PHILOSOPHICAL SOCIETY (Joint Session) (at Balliol College, Oxford) at 10 A M —C R Morris Dr Dorothy Wrinch and Prof L J Russell Symposium The Concept of Energy —At 2 30 —Dr Ivy Mackenzie The Biological Basis of the Sense of Time —At 8 30 —Prof J A Smith Prof A D Lindsay, and Dr F C S Schiller Symposium Croce s Theory of the Practical Nature of Science

SUNDAY, JULY 26

ARISTOTELIAN SOCIETY, MIND ASSOCIATION AND OXFORD PHILOSOPHICAL SOCIETY (Joint Session) (at Balliol College, Oxford), at 2 30 —P E More, Prof W D Ross, and Prof G Dawes Hicks Symposium Plato and Aristotle —At 8 30 —J MacMurray, C E M Joad, and A H Hannay Symposium Is Art a form of Expression or of Apprehension?

NATURE

SATURDAY, JULY 25, 1925

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The Future of the British Patent Office

I

THE British patent system suffers from certain rather serious defects which prevent it from fulfilling adequately its function as a stimulus to invention and as an incentive to the development of new manufactures It is the purpose of the present article to discuss one of these defects, namely, the restricted character of the investigation for novelty which is carried out by the Patent Office, and to direct attention to the need for fresh legislation on this subject Wide differences of opinion are likely to exist as to the form the remedy should take, since the relative cost of any schemes which may be put forward will depend on the degrees of thoroughness characterising the searches for which they respectively provide The view here advocated is that an extremely high degree of thoroughness will repay the expenditure which it involves, but we shall have served our purpose if we succeed in directing attention to the principal questions on which a decision will have to be taken when the present state of the law comes to be amended

At the present time the situation in Great Britain is as follows When a capitalist proposes to work a given patent, it is necessary for him to expend a certain outlay in plant, buildings and business organisation Before taking the financial risk involved, he naturally desires to have some degree of assurance that he can uphold his patent in the courts, that it will not be invalidated after he has committed himself irrevocably to his venture In the present state of the system, quite apart from the possibility of " prior user," which plays a small and diminishing part in such matters, and of "lack of subject matter," which does not entitle the patentee to much sympathy, he cannot have any such assurance For at any time after a patent has been granted by the Patent Office, it may be invalidated on the ground that, unknown to the patentee, an invention similar to his had previously been " made available to the public in some document published in the United Kingdom," such as a foreign patent specification or a technical journal

This state of affairs is keenly felt in manufacturing circles at the present time It discourages the investment of capital in new manufactures at a time when unemployment and foreign competition demand the fullest exploitation of new means for creating wealth, and it hampers inventors in turning to advantage their patent rights It is true that as regards anticipation by prior British specifications of the previous fifty years, the Patent Office does make a search which is marked by characteristic British thoroughness, but that search is a good thing spoiled, for it covers only a

fraction of the documents from which anticipations may afterwards emerge

Various remedies for this state of things might be proposed For example, if the Comptroller were simply to be empowered to enforce amendment to meet what are now called "extra-statutory citations," probably some sort of an extended search would be evolved in the course of a few decades, in an attempt to give fuller effect to these new powers Or again, as Mr W J Tennant once suggested,[1] the British search might be abandoned and the staff might devote itself to the formation of a universal index, in which applicants or their agents could search for themselves over a wide field Or if the present examining staff were to be diluted with personnel of inferior qualifications working under its direction, a comprehensive search of moderate cost and low efficiency could be instituted within a reasonable time We suggest, however, that the thing is worth doing well, and that means of a practicable character can be found to meet the cost of a far more ambitious scheme We propose that the Patent Office should undertake to search over substantially the whole area in which anticipating documents may be found, and that it should carry out this investigation with the same thoroughness that at present characterises its search amongst British specifications

In order to help in reducing the gap between the area covered by the search and that contemplated in the legal grounds for invalidation, the latter might be contracted somewhat For example, it is only in the most academic sense that an invention can be said to be anticipated by an identical invention published twenty-five years ago in German and then forgotten In fact, invalidation by publication might reasonably be restricted, in the case of foreign specifications, to a period of twenty years, at all events during the experimental stage of the extended search The effect of publication in periodicals might be restricted to a like period, since their essential subject matter passes in the course of time into text-books It might even be considered reasonable to rule that prior publication in any language other than English, French or German should not be deemed to invalidate a patent, and, again, it is by no means certain that the present law with regard to prior user gives the fairest balance between the rights of all the parties concerned

All the points referred to above require careful consideration by the patent lawyers, and if their decision be favourable, the scope of the extended search can be narrowed accordingly without defeating the object of the latter For our present purpose we shall assume that for all practical ends it will be sufficient to search amongst the patents published in the Dominions, France, Belgium, Germany, the United States, and Switzerland for the preceding twenty years, and to search for a like period all the relevant periodicals at present taken by the Patent Office Library, together with up-to-date text-books It would also be desirable for the Patent Office examiners to visit works regularly and make notes of standard practice, for apart from the utility of such notes, this plan would keep the outlook of the Office essentially practical and prevent it from becoming too academic

The advantages to be gained by instituting an extended search are many and important a few of them may be pointed out here As has already been argued, the confidence which it would establish would stimulate invention and the development of new manufactures, for it would remove the principal cause of the uncertainty which at present hangs over the patentees of obviously useful and ingenious inventions There is no need to labour this point, which will readily appeal to manufacturers, but it is important to note the effect of any step of this kind in reviving industry and so helping employment Then again, at the present time, inventors who wish to protect their inventions abroad have actually to make application in the countries they have selected before they can have any idea of the anticipations which are likely to be cited against them there, and the process of amending to meet the requirements under this head of the American or the German Patent Office is a troublesome and expensive one, which could largely be avoided if the specification had originally been drawn up in the light of full knowledge Internationally, too, the value of the British patent would be so much enhanced that it would acquire a dominating position in the patent systems of the world Applications which at present are sent from all parts of the world to Germany or the United States in order to obtain the results of a universal search might then come to Britain, provided that the present standard of thoroughness were maintained intact

It has been suggested that patents should be granted for the British Empire as a whole, so as to avoid the expense and labour which are incurred when a separate application has to be made in each of the component countries of the Empire A conference on this subject was held in 1922, but none of the technical staff of the Patent Office was present, and those who advised the chairman on behalf of the mother country were without personal knowledge of the essential work of examination and search As might be expected in these circumstances, the conference failed to handle successfully the extremely delicate technical question of an Empire search, in which the dignity of the

[1] W J Tennant, Presidential Address Transactions of the Chartered Institute of Patent Agents, 1917–18 vol 36 p 41

Dominions was concerned; in consequence, proposals were adopted which failed to win over the Dominion Governments, and the conference has proved sterile. To some small extent, however, the advantages which would have been gained by the institution of a competently planned Empire patent would be conferred by an extended search; at all events, a patentee who thought of protecting his invention in the Dominions would be able to find out beforehand whether any prior Dominion patent stood in his way.

The extended search would also make possible certain innovations which would cheapen patent litigation in the same way that the institution of Quarter Sessions cheapens criminal procedure. It would make it practicable to empower the Patent Office to deal with certain issues which at present are reserved for the courts, and in particular to grant suitably restricted certificates relating to the validity of patents, having an effect on costs similar to that of the certificates of validity at present granted by the courts. For during the five years 1920–1924, when the Patent Office sealed 83,166 patents and the Comptroller (together with the senior members of the scientific staff who share his judicial duties) gave decisions under the "novelty sections" (7 and 8) of the Patent Acts in 8831 hearings, there were only 7 successful and 3 partly successful appeals against those decisions. Hence no hesitation would be felt in entrusting the Patent Office with wider powers, provided that its Hearing Officers were given access by means of an extended search to the requisite range of facts. The effect of cheapening patent litigation in this way would be to protect poorer inventors against intimidation by the wealthy owners of bad patents, since the latter's bluff depends for its effect on the costliness of patent actions.

The last advantage of an extended search to which we need refer is one that especially concerns research workers. At present there is no very easy way of finding out the precise state of any technical art before embarking on research in connexion with it, and as a result labour is sometimes wasted in repeating work which has been done before, while investigators and inventors are deprived of knowledge which might be of the greatest value in solving for them various problems of design incidental to their main objectives. Now if the Patent Office were to undertake the kind of search we have indicated, it would become an encyclopædic source of information as to the current state of invention in all parts of the world, and the examining staff would become a body of experts able to supply, at short notice, fully documented information as to the methods which have been proposed and the problems that have to be solved in every kind of manufacture. If this information were to be available on payment of a suitable fee *before* the filing of a complete specification, it would enable inventors to put their inventions into the best practicable form.

In this connexion, considerable interest attaches to an article in *La Propriété Industrielle*, May 31, 1925, p. 93, urging the formation of an international classification, so that indexes should have the same sub-headings in all countries. That this in itself is not practicable can best be seen by means of an example. About 450 different varieties of the ordinary tumbler switch are comprised under the appropriate British sub-heading, and in order to determine precisely which switches shall and which shall not be included, a rigorous definition is necessary. The definitive heading adopted is:

Electric switches, etc.,
  kinds, etc.,
    snap-action switches (springs during a single on or off operation are first strained and then relaxed, to assist or to produce the switching movement) (*including* like snap action switches with gravity action, and snap action details of switches of all types),
      with operating levers and turn members having limited stroke.

In the United States, on the other hand, most tumbler switches would go into the file 200 (67), the heading of which is snappy rather than definitive, namely:

Electricity circuit makers and breakers,
  snap,
    oscillating contact,
      double snap.

It will be clear at a glance that these two files, though they overlap, do not necessarily cover the same ground. Now it sometimes happens that while attending an interview in an overcrowded room an inventor will overhear two examiners wrangling about classification. Let any one who has had this experience picture to himself an attempt to secure mutual agreement, by correspondence between the 160 patent offices of the world, as to (*a*) a definition of what is to be included in the file for tumbler switches, and (*b*) the manner in which that file should be subdivided. However, we may concede the main contention of the article referred to—which is that a universal index would be of the utmost value to the whole world—while at the same time we hold that a single nation must give effect to it.

We have now only to show that the scheme that has been outlined is practicable and that the cost can be met in an acceptable manner. For that purpose an examination of published statistics has been made, and the results will be described and considered in a further article.

Meteoric Astronomy

Meteors By Prof Charles P Olivier Pp xix + 276 + 23 plates (Baltimore Williams and Wilkins Co, London Baillière, Tindall and Cox, 1925) 30*s* net

A GREAT part of the most valuable work in recent years on meteoric astronomy has appeared in periodicals published in different countries As many of these are inaccessible to the average reader, Dr Olivier's book reviews a number of the most important of the articles appearing in the various journals, the more mathematical parts are segregated, so that the non-mathematical reader can omit these without losing the continuity of the work The researches of Dr Olivier and the American Meteor Society for several years on meteoric astronomy, the results of which are included in the book, render it both valuable and interesting, though probably differences of opinion will arise, especially amongst English meteor observers, on some of the conclusions attained

In the first chapter, "Historical Introduction," we have a brief account of the fall of meteors from the earliest times, the first record being found in the Book of Joshua, chap x The author believes that the narrative describes the fall of meteorites rather than hailstones We may remark, however, that Josephus affirms that thunder and lightning accompanied the phenomenon, which may indicate a fall of hailstones of unusual size, not meteorites The second chapter describes the methods for observing meteors, including those depending upon photographic work The mechanical apparatus of Rev M Davidson, referred to on p 14, and stated to have been described in the Journal of the British Astronomical Association, 30, p 92, is not, however, used for observing meteors, but for determining their real paths from the results of a double observation

Five chapters are devoted to discussing some of the chief showers, the Leonids, Perseids, Lyrids, Andromedids, Aquarids, and the meteors associated with the Pons-Winnecke comet In connexion with this first shower and its well-known relation to Tempel's comet, there is an obvious error on p 40, where it is stated that the orbit has a major axis of 10·34 astronomical units, and the aphelion point is 18 from the sun, but due to the inclination of the plane of the orbit to that of Uranus—about 16°—the meteors could never approach the planet within 5 astronomical units The *semi* major axis is 10·34, and though the inclination is 16°, yet at the ascending node the comet is about 18·8 from the sun, so that the meteors could come quite close to Saturn at times It appears as if Dr Olivier considered the axis major to be inclined at 16°, and then concluded that the comet would be 18 sin 16° from the plane of Saturn's orbit when at aphelion A very important point is discussed in connexion with the Perseid shower—the shift of the radiant by about 1° in longitude each night Denning was the first to show that there was this undoubted movement from July until about August 20, but Bredikhine held the view that the radiants observed in July and those probably after August 19 belonged to other streams or were partly chance accordances The work of the American Meteor Society, however, substantiates the existence of radiants in the positions assigned by Denning to the Perseid radiant from July 28 until August 18, though from July 21 until 27 the data are insufficient to affirm or deny Denning's positions It seems strange that some European observers should find little or no evidence of a regular motion of the Perseid radiant English observers have not generally disputed Denning's results

In Chap viii it seems to us that some of Dr Olivier's criticism is unfair In 1910 he announced, from observations of the Aquarids, that the connexion between Halley's comet and the η Aquarids was first definitely proved The radiant is not given in this chapter, but in a previous work, "175 Parabolic Orbits deduced from over 6200 Meteors," published in 1911, the radiants are given on the dates May 4, 6, 11, as 334°-3°·4, 337°·7-0°·6, 342°-0°·6 respectively In the British Association Report for 1874, p 349, Herschel pointed out the probable connexion, and also in the Monthly Notices of the Royal Astronomical Society, 1876, though Tupman's radiant 325°-2°·5 on May 1-3 was a considerable distance from the theoretical position, 337°-0° on May 4 In the Mon Not R A S, 1886, Denning states, from his radiant 337°-2°·5, April 30-May 6, "… the identity of the two orbits seems placed beyond doubt" The fact that Denning in 1899 was cautious enough to use the expression "probably associated with Halley's Comet," scarcely justifies Dr Olivier in claiming priority by saying he "definitely proved" the connexion in 1910 Again, on p 76, in discussing eight radiants, the author submits that Tupman's are the only scientifically observed ones, yet on April 29 Tupman's radiant is 329°-2°, and on May 2-3 it is 325°-2° Now, as Dr Olivier holds that the radiant moves about 1° in longitude each day, then Tupman's radiant on April 29 should correspond closely to 332°±0° on May 3 a position far from 325°-2° found then One cannot describe this as one of "the only thoroughly scientifically observed radiants" Indeed, Nos 4 and 7 by Denning and Corder correspond far more closely with the theoretical position for Halley's comet In addition to the points raised concerning the Aquarids, this chapter also discusses the meteors of Pons-Winnecke's comet, but the orbits published in the Monthly Notices of the Royal Astronomical Society, 77, 1916, are not

reproduced, as it is thought that the elements might be improved by another treatment and by having certain corrections applied In the paper referred to, it is thought that the shower extended from May 20 until July 10, though to the present writer this seems very doubtful, and possibly the author may modify his views later when he hopes to make this the subject of a new research

A considerable amount of discussion takes place on the question of stationary radiants, and a summary of the works of Von Neissel, Tisserand, Turner, Herschel, Bredikhine, Pickering, Plummer and Davidson is given Dr Olivier, as is well known, does not believe that stationary radiants as a rule exist, though the researches of those just mentioned show the possibility of such under certain conditions He admits, however, that approximately stationary radiants near the ecliptic may exist for considerable periods of time, but does not think that the same applies to radiants with high latitudes Denning was convinced of the existence of stationary radiants before any theoretical justification for them was advanced, and though most of these apply especially to radiants near the ecliptic, there is the possibility of reasons being given for others in the future

Those possessing elementary mathematical knowledge will find much interesting reading in such subjects as meteor orbits, real heights, perturbations of orbits of streams, formation of meteor streams from comets, etc The methods of computing orbits are almost identical with those published by Lehmann-Filhes, and many sections of Schieparelli's "Sternschnuppen" are reproduced The real heights of meteors are found by Schaeberle's method, and an example is given in Chap xv It seems to us that it is unnecessarily laborious, and the use of a celestial globe saves much time in this work Extreme accuracy cannot be attained, especially in finding the height of the beginning of a meteor, as the observers in different places do not usually see its commencement exactly at the same instant By taking the azimuth and altitude of the beginning and ending on a celestial globe and then using a good map, paths of meteors can be quickly found Davidson's apparatus described in the Journal of the British Astronomical Association, 30, p 92, is useful where one of the observers is doubtful of the position of the beginning or ending, but the direction of flight is well known The instrument itself automatically adjusts the ill-defined position

Dr Olivier's work covers practically every branch of meteoric astronomy, and should be extremely useful to those interested in this department The frequent use of split infinitives may irritate some readers, but this literary defect cannot be said to detract from the scientific value of the book

Cults and Customs in San Cristoval

The Threshold of the Pacific an account of the Social Organisation, Magic, and Religion of the People of San Cristoval in the Solomon Islands By Dr C E Fox (The History of Civilisation Series) Pp. xvi+379+14 plates (London Kegan Paul and Co, Ltd, New York Alfred A Knopf, Inc, 1924) 18*s* net

IT was a more than fortunate chance that threw together the late Dr W H R Rivers and Dr Fox while on a voyage to San Cristoval in the *Southern Cross* It was then that the interest of the latter in anthropology was aroused by Rivers's genealogical investigations These he regarded at first with some amusement, but as time went on he came to be drawn to the study of the customs and beliefs of the people among whom his work lay as a missionary, with as serious a purpose as that which inspired Rivers himself

Anthropologists have long been aware that this book was in preparation The manuscript was in Rivers's hands at the time of his death, but the work of editing was still unfinished, and the task of completing it has devolved upon Prof Elliot Smith with the assistance of Mr W J Perry The expectations which had been aroused by the publication of part of Dr Fox's material in the Journal of the Royal Anthropological Institute are fully justified by the completed work, which, it is no exaggeration to say, will take high rank among the works which record first-hand study of primitive peoples Dr Fox writes with the intimate knowledge which comes from careful inquiry as well as long acquaintance with the subject matter, yet he retains a freshness of observation undimmed by familiarity, which serves to carry his reader through a mass of detail without even a suggestion of weariness

San Cristoval, which lies at the south-eastern end of the Solomons, is divided into several large districts, which differ considerably from one another both in social organisation and in beliefs and custom Broadly speaking, the west end of the island, which Dr Fox, extending the strict geographical application of the name, calls Arosi, and Kahua—the eastern end—together with the outlying small islands, differ from the central area Bauro in that they are organised on a totemic basis Bird clans occur in the west in Arosi, aquatic clans to the east in Kahua, and both are found along the coast of the central part In the district of Bauro, of which, however, Dr Fox knows part only, the people of the interior have a dual organisation Although there are some totemic clans on the coast of this district, as mentioned above, it is clear that the dual organisation underlies them, as might perhaps be expected

The relationship terms in this district appear to differ from those in any other part of Melanesia in that all the terms and all names have prefixes to distinguish sex, the term used depending upon the sex of the person to which it is applied

Dr Fox has paid special attention to the very interesting serpent cult, which has its home in the Bauro district This cult has many peculiar features, well brought out in the legends connected with the snake which he quotes Pools, rocks, and waterfalls or large trees are thought to be the abode of *hi'ona*, *higona*, or *figona*, the last being the term Dr Fox prefers to use throughout These spirits are never seen, but others, the chief *figona*, had a serpent incarnation only In this they differ from the *Adaro*, some of whom are ghosts, others, spirits who have never been men These could take the form of men, dogs birds, snakes, trees, or clouds The *figona*, however seem to be connected with stone worship in addition to their serpent incarnation, for they could take the form of, or withdraw into, stone Of these serpent incarnations, Dr Fox regards one known as Agunua as " almost like a supreme spirit " and partaking in some sort of the nature of a divine demiourgos It would appear that particular *figona* are regarded as local representations of Agunua Dr Fox is also inclined to the view that the worship of Agunua was once widespread On the whole, however, although the legends of Agunua are connected with the creation of certain things, as, *e g*, the coming of fire, he scarcely functions in the rôle of creator, and the evidence upon which supremacy is attributed to Agunua appears to be too slender for any positive conclusion

Dr Fox has naturally paid considerable attention to the system of relationship—a study for which Rivers's genealogical method has done so much His results, however, are an illustration both of the strength and weaknesses of that method He gives a very candid account of the difficulties into which he was led until he discovered the discrepancies introduced into his information by the practice, which Rivers himself noted, of marriage and adoption out of the correct generation One result of the custom of adoption—amusing enough to us, although it offers nothing incongruous to the native mind—is that a boy may be adopted as a father or a grandfather, and thus stand in either of these relations to those who are his coevals

" The Threshold of the Pacific " can be considered under two aspects On one side, Dr Fox records the results of his observations, and in this his work is deserving of the highest praise On the other, he seeks to draw ethnological conclusions from his material, and what is really unfortunate, these two aspects are not kept rigorously asunder as they should be The reader, therefore, may perhaps be pardoned if he has an uneasy feeling that Dr Fox, in dealing with certain remarkable features in the culture of the San Cristoval, such as the custom of embalming, the modes of burial, the winged serpent belief, etc, has allowed his judgment to be unduly influenced by analogies which undoubtedly may be found in ancient Egypt He argues that San Cristoval has been peopled by four distinct groups (1) The Amwea moiety of the dual organisation, (2) the Atawa moiety of that organisation, (3) the Abarihu, part of whom constitute the Araha ruling group, and (4) the people who practise cremation So far this would seem a not improbable interpretation of the evidence Dr Fox, however, goes further and points out that many customs of the Araha exhibit similarities to the cultural complex which has been attributed to the people of the " archaic civilisation " of Indonesia as described by Prof Elliot Smith, and make strongly for their identification with that hypothetical culture This, as will be seen from a careful perusal of Dr Fox's final chapter, has involved him in considerable difficulties, owing to the fact that certain elements of that culture are entirely absent, while others, though present in San Cristoval, do not attach particularly to the Araha The discrepancy is apparent to Prof Elliot Smith, who suggests an alternative explanation in his introduction

It is not proposed to enter here into a discussion of the significance of the similarities of the Araha culture to those of the " archaic civilisation," such as embalming, the burial mounds (called " mastaba " in a diagrammatic illustration of a burial mound, but not in the text) with superimposed dolmens, the winged serpent Hatuibwari, the " double " which goes into a stone statue, and the like It is well known that Dr Rivers and Prof Elliot Smith were both greatly impressed by the evidence collected by Dr Fox which appeared to point to the culture of ancient Egypt as the nearest analogy How far Dr Fox's judgment may have been influenced by that fact it is impossible to estimate, but in the preface it is stated

" Rivers was virtually Fox's only channel of communication with the ethnological world Hence it is no matter for surprise that the isolated worker in distant Melanesia was profoundly swayed by Rivers' views, even in some cases when his own evidence came into conflict with them In respect of these points of difference, it is unfortunate that Dr Fox is so far away as to make discussion even by letter virtually impracticable Hence I have felt obliged to leave certain of his statements in a form which I feel sure he would have agreed to modify, had discussion been feasible "

This statement is a little perplexing and might, with advantage, have been made more precise

X-rays in Research

La technique des rayons X Par Dr A Dauvillier (Recueil des Conferences-Rapports de documentation sur la Physique, vol 10, 2e serie Edite par la societe *Journal de Physique*) Pp 195 (Paris Les Presses universitaires de France, 1924) 22 50 francs

DURING the first seventeen years after the discovery of X-rays in 1895, the development of apparatus for their production was chiefly influenced by the requirements of medical radiologists Progress was rapid, and attempts at standardisation were swept away by a flood of ideas, applications, and devices In the year 1912, however, a great advance in a new and purely physical direction was made possible by the work of Laue Following this lead and under the inspiration of Rutherford, Moseley, Bragg, de Broglie, Duane, and others, physical research in which X-rays play a conspicuous part has now become of outstanding importance

Since the immediate questions opened up by this work and by the problems ever before the medical radiologist differ somewhat in their scope and aim, it is not surprising that the appliances evolved in the laboratory for X-ray research work should have come to be very different from those used to-day in medical practice This evolution is traced out by Dr Dauvillier in his book It is essentially a work for those who are already somewhat familiar with the subject, and to whom the general information given at the beginning will serve as a useful reminder of the progressive steps by which our present knowledge has been attained On p 35, however, the author is in error in attributing the first X-ray tube with slanting anticathode to Mr A A Campbell Swinton instead of to Sir Herbert Jackson, who, in fact, actually made it with his own hands

After referring to the construction of "gas" tubes and their mode of regulation, we reach the section of the work dealing with the hot cathode device due to Lilienfeld and Coolidge It is here that the value of the book is most apparent, for the author has brought together much valuable information which was previously scattered, and therefore only accessible with difficulty The applications of the hot cathode idea are considered in detail, and the modification of the usual radiographic type of tube to suit the special requirements of the laboratory is explained and illustrated We thus have the advantage of studying the design of the modern tubes employed in X-ray spectroscopy, with full notes of the difficulties to be met with in their use and the means of overcoming them, written by one who is himself an accomplished experimenter Incidentally, since most of these tubes require to be continually exhausted of gas while in action, the author refers to the latest pumping methods, and gives an interesting description of a tube with liquid anticathode and also of one with a gaseous target

The medical radiologist is, of course, gaining valuable data from the purely physical work on absorption and scattering of X-rays under various conditions, as well as from the study of the energy distribution in X-ray spectra, and he is also beginning to realise the desirability of utilising for his work a type of electrical plant that will provide a constant current at a pressure of, say, 200,000 volts Apparatus of this kind was first set up in the United States for careful physical work on X-ray spectra, and a modification of the plan then adopted, and due largely to Dr Dauvillier himself, is now being developed in France Germany, too, is actively manufacturing constant current high voltage plant for X-ray work The author has therefore wisely devoted a whole chapter to this important matter

With regard to protection, there is no mention of the recommendations of the X-ray and Radium Protection Committee which were issued in 1921, and the author is perhaps too definite (p 114) in referring to what he considers a safe minimum radiation intensity It is felt by many that we are not yet quite sure as to the biological effects of exposure to a very feeble radiation over long periods of time continuously

The book deals towards the end with the vexed question of X-ray measurement, a subject to which Dr Dauvillier has himself made some notable contributions Finally, there are brief references to medical, industrial, or other applications of X-rays

We recommend this work to all physicists who are engaged upon researches in which a technical knowledge of the subject is indispensable It is clearly written, well arranged, and fully illustrated Its use would be still further enhanced, however, by the provision of a more adequate index, or at least the revision of the existing "table des matières," where in several instances the page numbers do not agree with the references in the text

C E S P

The New Principia

Principia Mathematica By Prof Alfred North Whitehead and Bertrand Russell Second edition Vol 1 Pp xlvi+674 (Cambridge At the University Press, 1925) 42s net

THE great achievement of the authors of "Principia Mathematica" is to have deduced mathematics by strict symbolic reasoning from a small number of logical propositions This was previously attempted

by Frege in his "Grundgesetze der Arithmetik," but without success For his axioms, like those of most logicians, were found to imply contradictory consequences, such as the famous paradoxes of the theory of aggregates In particular, both the thesis and antithesis of the well-known contradiction about the class of all classes not members of themselves could easily be deduced from Frege's primitive propositions

To escape this difficulty, Prof Whitehead and Mr Russell invented the theory of types, by which both the thesis and antithesis of such contradictions were ruled out as strictly nonsensical By means of this theory they succeeded in constructing a system adequate for the deduction of mathematics and, apparently at least, free from contradiction But this system was not entirely satisfactory apart from the reductions in the number of primitive ideas and propositions, which have been effected by Sheffer and Nicod, the principal need for improvement was in connexion with the "Axiom of Reducibility" This axiom was introduced to justify a common form of mathematical reasoning, which would otherwise have been invalidated by the theory of types

Unfortunately, the axiom is by no means obviously true, and was only put forward because no less objectionable assumption could be found which would justify the ordinary theory of real numbers and Dedekind section This unsatisfactory state of things led Weyl and others to reject the theory of real numbers as groundless, and to try to construct a truncated analysis without using Dedekind section Consequently the main interest of this new edition of "Principia Mathematica" lies in its treatment of the axiom of reducibility

The authors have left the text of the work unaltered, to avoid the enormous labour of changing the references throughout three volumes, but have added a new introduction and appendices The introduction contains a much simplified exposition of the theory of types, and the outlines of a new theory in which the axiom of reducibility is replaced by a new assumption suggested in the first place by Wittgenstein for philosophical reasons This new assumption is entirely unobjectionable, because it is of such a form that it could be made a mere matter of definition Unfortunately, it is not nearly so fertile as the axiom of reducibility, and whole branches of mathematics, such as the theories of infinite cardinals and ordinals, of mathematical induction, and of real numbers and Dedekindian series require a new treatment

The authors have only succeeded with this new treatment in one of the important cases, namely, mathematical induction, of which a full account is given in one of the appendices, there with great ingenuity and arguments involving functions of the fifth order, all the usual theorems are established without using the axiom of reducibility On the other hand, the authors confess that "There is, however, so far as we can discover, no way by which our present primitive propositions can be made adequate to Dedekindian and well-ordered relations It might be possible to sacrifice infinite well-ordered series to logical rigour, but the theory of real numbers is an integral part of ordinary mathematics, and can hardly be the object of a reasonable doubt We are therefore justified in supposing that some logical axiom which is true will justify it The axiom required may be more restricted than the axiom of reducibility, but, if so, it remains to be discovered" It seems, however, possible that the whole trouble really arises from defective philosophical analysis, and that if the theory of types were suitably modified all need for any such axiom would disappear But this possibility is not considered by the authors, in spite of the fact that the work of Wittgenstein, for which Mr Russell has expressed such admiration, appears to point in that direction

The three new appendices deal with the "Extension of the Theory of Deduction," of which a new account is given based on the work of Sheffer and Nicod, with the new theory of mathematical induction, and with the new and paradoxical philosophical assumption that all functions of propositions are truth-functions, which is defended by various subtle distinctions We may regret the absence of any reference to the question of identity, or answer to the criticisms of Wittgenstein, "from which," Mr Russell wrote in his introduction to "Tractatus Logico-Philosophicus," "there seems no escape" A useful addition has been made in the form of an index of definitions

Although it still achieves no final solution of the difficulties, "Principia Mathematica" is likely to remain for many years the standard work on the subject, and its republication is a most important event

Oats

Oats their Varieties and Characteristics, a Practical Handbook for Farmers, Seedsmen, and Students By Herbert Hunter (Practical Farming Series) Pp 131 (London Ernest Benn, Ltd, 1924) 8*s* 6*d* net

It is a matter of some significance that this book is addressed to the seedsman equally with the farmer and student, for in the past it has not been sufficiently realised to what a large extent successful crop production is determined by the suitability, genuineness, and quality of the seed employed The manner in which Mr Hunter has treated his subject should of itself be

valuable to the seedsman and to the farmer, as showing that the problems of both are in many details essentially the same, and are only to be solved to the mutual advantage of the two interests by painstaking and accurate methods of research

The origin of the cultivated oat is briefly discussed, and the author does not accept it as definitely proved that the varieties of *Avena Sativa* have originated from the wild oat (*Avena Fatua*), although he would seem to regard the appearance of "false wild oats" amongst the cultivated varieties as an indication of "degeneration" towards the wild type In this connexion it may be remarked that false wild oats occur equally amongst the oldest varieties like Welsh sprig and the newest like Victory, and in fact probably occur amongst all the cultivated varieties of *Avena Sativa* The botanical characters of the oat, particularly such as are valuable for discriminating between one variety and another, are adequately dealt with in simple language

The body of the book is devoted to a description and classification of the chief varieties of oats, and the economic value of each variety is briefly discussed, while in a concluding paragraph the reader is reminded that varieties with a distinctly early ripening habit are not recommended for normally early districts The descriptions of the varieties have been based on material grown under the author's supervision, and he has used the various characters of panicle, grain, straw, growth habit, and time to reach maturity in a manner very similar to that of Marquand and others, who have also critically studied the varieties of oats

Distinction is made between *Avena Sativa Orientalis* and *Avena Sativa* proper, the latter is divided into the following five sub-groups, which can be easily and satisfactorily differentiated "winter hardy," "semi-winter hardy," "potato," "abundance," and "early ripening" Keys are given to the different varieties in relation to the groups and to the varieties of *Avena Sativa Orientalis* The value of this section of the book would have been enhanced had the author dealt with the question of synonyms, and since in practice the greatest difficulties occur in the recognition of the varieties of the "abundance" division and between some of the newer of the Tartar-like varieties, it is to be hoped that in a subsequent edition of the book such varieties will be described in greater detail

A comparatively long chapter is devoted to the chemical composition of the oat grain, in which the researches of Brenchley, Brenchley and Hall, Berry and others are faithfully discussed Although valuable to the student, this chapter is likely to prove wearisome to the seedsman and the farmer Excellent chapters on seed selection and the production of pure seed conclude the book The text is supported by eighteen extremely good figures, which are very typical of the varieties they represent

No mention is made of the diseases of oats, although the reaction of varieties to disease must at the present time be regarded as one of their most important characters

Output of Scientific Papers

Catalogue of Scientific Papers Compiled by the Royal Society of London Fourth series (1884–1900) Vol 19 T—Z Pp vi+877 (Cambridge At the University Press, 1925) 168s net

WITH the publication of the volume before us, the indexing of the scientific papers of the nineteenth century under their authors' names has been successfully brought to a close It is unnecessary to reiterate the high opinion which we have previously expressed of the practical utility of this monumental undertaking and of the high standard of accuracy maintained by its successive editors and their staffs The "Catalogue of Scientific Papers" is an indispensable tool for the research student and historian of science alike

Its value for statistical purposes, however, has not been equally recognised No statistics were published in the prefaces to the first three Series and their Supplement, but a rough estimate made from a calculation of the average number of entries on a page gives the following results

Period	No of Author Entries	Yearly Average
1800–63	195,120	3,097
1864–73	80,070	8,007
1874–83	100,750	10,075
Supplement	26,560	320
1884–1900	384,478	22,616

After 1900 the work of the Royal Society was continued on a greatly extended scale in the International Catalogue of Scientific Literature Approximate figures of the output of this body were published by the present writer in a work reviewed in NATURE on October 20, 1923, pp 585-6 The figures are as follows

Year	No of Author Entries	Year	No of Author Entries
1901	43 440	1908	75,034
1902	49,896	1909	70,030
1903	49,264	1910	85,519
1904	50,741	1911	74,773
1905	73,034	1912	69,323
1906	74,877	1913	62,799
1907	74,327		

These figures suggest a curious parallelism between the movements in western science and civilisation in the first thirteen years of the twentieth century Coupling the two sets of statistics it will be seen that the output of scientific papers showed continuous progress from

1800 until 1910—the rate of progress accelerating rapidly between 1884 and 1910—the peak year of scientific activity

These figures, imperfect as the basis for their compilation admittedly is, deserve the attention of statisticians, and it is to be hoped that in future consolidated author indexes published by the Royal Society, the statistical value of the data contained therein will be kept in view E W H

Our Bookshelf

Living Organisms an Account of their Origin and Evolution By Prof Edwin S Goodrich Pp 200 (Oxford Clarendon Press, London Oxford University Press, 1924) 6*s* net

PROF GOODRICH has written a wholly excellent introduction to biology The opening chapters deal with the elementary principles of biophysics and biochemistry, and with the nature of life, reproduction and death The remainder of the book is taken up with an exposition of the facts and theories of evolution, and the author has here given a very clear account of the present state of knowledge of heredity and allied problems, and of the latest advances which have been made in this field, both from the experimental and cytological aspects The book is intended mainly for the general reader, and the author has therefore been meticulously careful to define exactly the terms which he uses There can be no doubt at all in the mind of the reader as to what he means by such terms, for example, as inheritance, variation and character This clarity of meaning is particularly emphasised in his treatment of the vexed question of the inheritance or not of so-called acquired characters Reiterating the view of Sir Ray Lankester that the characters of organisms are in the nature of responses to environmental stimuli acting on a complex of germinal factors and must be made anew at every generation, he advocates, with the late Prof Sedgwick, that the popular distinction between acquired and not acquired characters is illusory, and pleads for the abandonment of the expression "acquired" character altogether

There is much to be said in favour of this view The true Lamarckian theory of evolution demands the production of changes in the germinal factors of inheritance as the result of environmental stimuli, and of this there is at present no convincing evidence At the present time, when the Lamarckian position is receiving so much attention at the hands of scientific workers, it is particularly desirable that the general reader should have before him a clear and simple explanation of the situation which will enable him to understand the problem and appreciate the nature of the evidence brought forward for or against the theory The student of science, too, will find much that is helpful in this excellent little book

The New Decalogue of Science By Edward Albert Wiggam Pp 287 (London and Toronto J M Dent and Sons, Ltd, n d) 7*s* 6*d* net

SCIENCE has its natural enemies—it has also its unnatural friends Nothing could be more distasteful to a genuine student than this hymn to science—a sort of Main Street Nietzscheanism The writer assures us that it is "no extravagant assumption, but the surest deduction from science itself, that science only can supply mankind with the true technology of the will of God" This Will is brought down to us in the New Decalogue, written down mainly for the statesman who, we are told, decides "who shall survive and who shall perish in the struggle for existence," who "in a real sense determines the very trend of human evolution" The belief in Divine Will, in science and in statesmanship leads to such views as the following "that the advanced races are going backward," "that medicine, hygiene and sanitation will weaken the human race," "that morals, education, art and religion will not improve the human race"—all these are chapter headings

We are ready to admit that "pauperism is as distinctly inherited as the capacity to create wealth" or perhaps even more so But the author's proof sounds like insufficient induction "I know one family in which in a hundred and fifty years not a single member has saved up five hundred dollars" We are at first shocked to hear that "Vice and disease purify a race Wickedness, folly, sin, are all nature's methods of racial purgation" But we acquiesce when we are told that "the old Hebrew statesmen saw this principle of nature as clear as day They constantly said in substance 'The children of the wicked are cut off,' 'The fool shall perish by his own folly,' 'The wages of sin is death'" All this apparently shows that modern biology could be taught from the Old Testament

The worst of it is that the book, written in a thoroughly unscientific spirit, yet advocates many good things such as eugenics, biometric research, application of biological conclusions to sociology and politics—all of which are bound to suffer from such advocacy No wonder that a professional, though not very dangerous, enemy of science, Mr Bernard Shaw, has easy play with the book in a letter which the author has proudly appended to the volume It is both unpleasant and difficult to safeguard the interests of science from such benevolent and enthusiastic propaganda of its self-appointed apostles B M

Adventures of Exploration By Sir John Scott Keltie and Samuel Carter Gilmour Book 1 Finding the Continents Pp iv+128+4 plates 1*s* 6*d* Book 2 Central and South America Pp iv+156+4 plates 1*s* 8*d* Book 3 Asia Pp iv+164 1*s* 10*d* (London George Philip and Son, Ltd, Liverpool Philip, Son and Nephew, Ltd, n d)

"TRAVAILE," said Bacon, "is a Part of Education Let Diaries, therefore, be brought in use" The authors of these books on adventures of exploration have ransacked the diaries of the world's greatest travellers to describe in simple language some of the outstanding expeditions by which the world has been discovered by and for Europeans The stories range in "Finding the Continents" from the epoch-making voyages of Columbus to those of Barents and Cook in the northern and southern seas South America forms the scene of exploits from Cortes in Mexico and Pizarro in Peru to Fitzgerald's magnificent failure on the height of Aconcagua and Roosevelt's voyage on the River of Doubt In Asia, between the romantic

journeys of Marco Polo and the tragic struggles to conquer Everest, there are a dozen stories of adventure and daring, not merely to lay bare the secrets of Nature, but to inquire into the habits and the life of man De Lesseps in Siberia, Manning at Lhasa, Layard in Persia, Garnier on the Mekong, Burnaby at Khiva, and Doughty in Arabia, these are some of the adventurous travels sketched lightly and interestingly in this book Useful sketch maps, recalling in their style and ornament the old maps of travel, make the narratives of special value and justify the authors' hope that these "supplementary readers" will quicken interest in geography by stories of adventurous travel The selection has been well made, and the narratives not only afford an idea of some of the main steps by which knowledge has been gained, both of the world as a whole and of the separate continents other than Europe, but show also how many place names owe their origin to explorers, and recall incidents of exploration

A Brief History of Civilization By John S Hoyland Pp 288 (London Oxford University Press, 1925) 3*s* 6*d* net

We ought to welcome the efforts, which are now becoming so frequent, to present the history of mankind as one, a progressive thing, culminating in a unity of which the League of Nations is the symbol and organ Mr Hoyland's little book is the best we have seen at the size and price, and it is published by the Oxford Press, which is distinguishing itself for works tending in that direction Kant's prediction of the course of history-writing, made in 1782, is beginning to be realised in our day, that part and type of history is being most studied and commemorated which tends to the general good of mankind Mr Hoyland is possessed by this idea, and consequently gives us an appreciative account of China and a full, though discriminating, judgment of the contributions of Greece and Rome There is also more, though not so adequate, allusion to the rôle of science in history than would be found in most books of earlier date

The less effective part of the book is the last third, where the facts are so multitudinous as to occasion more compression and generalisation, and we think the general treatment suffers by the emphasis on the evils of nationalism and the discussion of problems raised by the growth of internationalism It is really better, from the author's own point of view, to describe sympathetically what the various nations have done towards the common end than to dilate on the underlying problem In practice this means more space *all through* to the triumphs of science, invention, and various forms of international association, rather than relegating all these topics together to one concluding chapter But the book on the whole is sound and useful, and a great advance on anything of the kind yet attempted, and it is admirably illustrated and produced F S Marvin

Essentials of Scientific Method By Prof A Wolf Pp 160 (London G Allen and Unwin, Ltd, 1925) 5*s* 6*d* net

Prof Wolf's delightful book should be in the hands of every teacher of science It is written with an admirable lucidity, and treats its subject in such a plain and straightforward way that no previous knowledge of logic or psychology is necessary for its comprehension Most science teachers are interested in the philosophy of scientific method, but comparatively few have the leisure to make a thorough study of it To the busy majority Dr Wolf's book will prove of great interest and value, and for the others it will provide a convenient epitome

The author does not go deeply into the fundamental question whether the world which science describes is a world of reality, and in this he is wise He confines himself to a description of the methods actually employed by science to obtain those results which are familiar to every one His treatment of "Order in Nature and Laws of Nature" is a particularly skilful exhibition of skating upon thin ice, but there can be little criticism of the position he adopts "On the whole," he says, "experience has shown that there is some order in nature, even if nature be not orderly through and through" We cannot agree with him, however, when he says (p 126) that it is not very likely that Boyle's Law and similar generalisations would be assumed to hold good of newly discovered substances without experimental verification E J H

La matière vivante organisations et différenciations, origines de la vie, colloides et mitochondries Par Prof J Kunstler et F Prevost Pp 253 (Paris Masson et Cie, 1924) 18 francs

This rather curious booklet contains an exposition of the authors' views on the structure of protoplasm Their main contention is that the structural organisation of protoplasm is as important for the processes of life as is its chemical composition With this few would disagree, especially after the remarkable experiments of Warburg and others upon the rôle of structure in such fundamental activities as respiration

The book, however, is uncritical and one-sided All sorts of structures are lumped together, and the work of others is very unequally treated Little attention is paid to the views of such authorities as E B Wilson, R Chambers, and others, that the visible structure of protoplasm may readily change in accordance with change of physiological state, nor is there any proper discussion of modern work on micro-dissection or physiological cytology

The work will be of some interest to the specialist, but can scarcely be recommended to the general biological reader

The Annual Register a Review of Public Events at Home and Abroad for the Year 1924 Edited by Dr M Epstein (New Series) Pp xv+326+171 (London Longmans, Green and Co, 1925) 30*s* net

This admirable survey of the year's history is planned on the lines which have been long familiar An account of British history, followed by foreign and imperial history arranged under the headings of the various states, occupies two-thirds of the volume Then come a tabular chronology of events, a survey of literature, art, music, science, law and finance, and obituary notices of the year These surveys are necessarily very condensed, but lack neither lucidity nor critical estimates of the field of survey Some of the more important treaties and agreements of the year are printed in full

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Ether-Drift and Relativity

DR. SILBERSTEIN's deductions from Prof. D. C. Miller's surprising optical experiments, as contained in NATURE for May 23, are equivalent to stating that there is a drift of the ether with respect to the earth, and the horizontal component velocity of this drift is very small at ordinary ground level but rapidly increases with height z, so that it reaches about 10 km./sec. at the height of Mt. Wilson (1.731 km.), whence $\delta u/\delta z = 5.7$ sec.$^{-1}$ approximately for the intermediate zone. The mere existence of this measurable drift would be in conflict with the very foundations of relativity.

Objection against these conclusions is raised in NATURE for June 6 by Prof. Eddington, who remarks that the described ether-flow being strongly rotational, it could not satisfy Stokes's condition for non-influence on astronomical aberration; and the consequences would be in disagreement with the measurements made every day in astronomical observatories.

I think that from the mathematical point of view this objection may be removed on remarking that it takes into account only the horizontal component of the drift. If x is the co-ordinate in the direction of this component, and w is the vertical component of the drift, the full expression for the *curl* of the drift-velocity in the xz plane is $\delta u/\delta z - \delta w/\delta x$, and therefore the flow might be everywhere irrotational, even with a high value of the term $\delta u/\delta z$, provided there is a corresponding $\delta w/\delta x$ to match it.

It is true that in the light of the first theory given by Stokes and expressed by Lorentz in his standard book "The Theory of Electrons," Ch. v., 147-148, the irrotationality of the flow would not be sufficient to destroy the influence on aberration, and certain additional conditions ought to be satisfied by the velocities of the ether near the stars and near the earth. But a careful consideration shows that the aberrational effects as observed by astronomers do not depend on the differences between the directions on the wave normals at the origin and the end of the light-ray, as considered in the above theory, but exclusively on the paths of the light-rays themselves. Therefore, the right theory to be employed is the second one given by Stokes with Challis's corrections, and further developed by Larmor in "Aether and Matter," iii. 22, according to which the irrotationality is the only condition required.

In the light of this conclusion, Planck-Silberstein's hypothesis of an irrotational and extremely compressible ether with a negligible drift at ground level might be sufficient to secure agreement with all standard astronomical measurements at all heights, and with terrestrial geodesic observations (absence of geodesic aberrations); but it requires a compression so high as 60,000 at sea-level; and it further requires that the "grip" of the earth on the ether be purely gravitational, according to Silberstein's vivid expression, because Michelson and Gale's experiment has shown that the ether does not follow the daily rotation of the earth. Even a broader theory might be adopted, since the latter experiment, performed inside an iron pipe, shows that the pushing forward of the ether by the earth, if any, is not due to impenetrability or to adhesion to material surface, and therefore Planck's condition that the vertical flow of the ether at ground level be zero may be discarded.

Three points of difficulty are, however, to be considered, namely:

(1) To show that an irrotational distribution of flow can be effectively mapped out, which numerically agrees with the various values of the horizontal velocity found by Prof. Miller at different heights and times.

(2) To explain why, since the grip on the ether is not due to material surface adherence, its horizontal drift is reduced so nicely to zero at about sea-level and not to any other level whatever.

(3) Since $\delta w/\delta x$ requires to be so high as 5 or 6 sec.$^{-1}$, it follows that if the vertical drift be zero at a certain point, it will be about 500 km./sec. at some point at 100 km. distance at the same level. If there is a vertical ether flow of this magnitude, it will be revealed at once by very common electromagnetic experiments or by a quite unrefined repetition of Prof. Miller's experiment in a vertical direction.

In the present condition of things it will be advisable not to draw any conclusion from Prof. Miller's experiments until results of further experiments are available, and until, finally, we are able to examine whether some unknown phenomenon has affected the results.

GIOVANNI GIORGI.

University of Rome
(Regia Scuola d' Ingegneria),
June 29.

P.S.—Since writing the above, I have seen Prof. Miller's article which appears in the issue of NATURE for July 11, giving further and very interesting particulars on his experiments. My conclusions are not modified by it.

G. G.

Experimental Study of the "Soaring" of Albatrosses.

THE letter by M. Idrac, under the above title, in NATURE of April 11, was one constituting an earnestly important contribution to the fascinating subject of soaring flight; for it is undoubtedly the case, that so far as the sea considerably impedes the lower strata of the wind, an albatross must be able to soar in the manner recorded. The methods of energetics (having regard to the internal energy of the air) may certainly be employed to indicate this, but the less often used acceleration-of-headway method may be employed as a simple, precise kinematical alternative. For example, when the bird in its relationship to the enveloping air is gliding upwards at an angle α degrees above the horizontal, at a headway of V feet per second, and against a wind from the north, it is tending to lose headway gravitationally at the rate of $g \sin \alpha$ feet per second per second. It may also be regarded as tending to lose headway frictionally, at the rate of g/n feet per second per second, where n is the ordinary lift/drag ratio. On the other hand, if the higher strata of the wind are travelling faster southwards to the extent of v feet per second for each foot of vertical height, the bird tends to gain headway at the rate of $Vv \sin \alpha \cos \alpha$ feet per second per second, because $v \cos \alpha$ feet per second is the component of increment of wind velocity head on to the bird, per foot change of height, and $V \sin \alpha$ feet per second is the vertical rate of gain of height. Accordingly, for the bird to continue gliding upwards at steady or increasing headway it simply needs to have

$$Vv \sin \alpha \cos \alpha - g \sin \alpha - g/n \nless 0, \qquad (1)$$

that is to say, not negative.

From (1) is deducible for calculation,

$$v \lessdot \frac{g}{V}\left(\sec \alpha + \frac{2}{n}\operatorname{cosec} 2\alpha\right) \qquad (2)$$

For every angle α at which the bird may choose to steer upwards there is therefore a certain v of the air which will keep the bird gliding without losing headway, but the particular angle α that allows v to have its minimum serviceable value, and in which therefore we are most interested, is ascertainable from (1) or (2) to be governed by the condition that

$$(2 \operatorname{cosec} \alpha)/(\sec 2\alpha - 1) = n, \qquad (3)$$

quite independently of what the V of the bird may be For the following values of n—

$$0,\quad 1,\quad 5,\quad 10,\quad 15,\quad 20,\quad 30,\quad 50,\quad \infty,$$

formula (3) determines these corresponding approximate values of α,

$$45°,\ 38°,\ 28°,\ 24°,\ 21°,\ 20°,\ 17°,\ 15°,\ 0°,$$

or about twenty degrees for the whole range of values of n usually found in practice In particular, the birds with $n = 18$, observed by M Idrac, have the comparatively steep angle of 20 4 degrees as the best angle α up which they should prefer to steer in this kind of soaring Inserting therefore this value of α in formula (2), and also inserting the observed value of 72 feet per second for the value of V it transpires that those birds may soar steadily upwards against the wind when v, the increment of wind velocity per foot of height, is not less than 0 552 feet per second If v exceeds this the bird will not merely not lose headway, but actually be able to gain headway, even for a range of upward angles α a little greater and a little less than the best angle of 20 4 degrees of this case This width of range of angles, less than and greater than the best, increases when v is increased, according to values deducible from formula (1) or formula (2)

It is notable that in formula (2), v is inversely proportional to V, quite confirming the observations made, that the birds of greater headway more easily perform this kind of soaring, but at very great headways and for the whole soaring manœuvre this rule tends to reverse, when the energy-wasting reactions of sharp turns, up and down as well as sideways, with large birds and especially with large aeroplane appliances, are taken into account As regards rules this seems the place to recall that the best angle of ascent has no connexion with V but only with n, and that the best angle of ascent is not very sensitive to ordinary differences in even n, nearly always wanting to be about twenty degrees—a simple rule for bird or man

For the return or southward journey we may use the same expression (1), but with the sign of the gravitational middle term made positive, and with the angle α measured downwards from the horizontal and we can insert the minimum value of v just found and supposed to be prevailing, that is, 0 552 feet per second The angle α so determined for a steady glide for the bird of headway 72 feet per second is then a mere 1 4 degrees downwards from the horizontal Truly it is downwards and not upwards, but as it is only about half the ordinary gliding angle, the bird evidently obtains some soaring assistance even on the return journey

The whole indicated procedure of the bird, then, as viewed from the east, and entirely corresponding to observations made, is to glide to the right and steeply upwards from the surface of the sea, until it reaches the height where v ceases to be so great as 0 552 feet per second If this height is 100 feet, the bird takes 100/(72 sin 20 4°), or about 4 0 seconds to arrive There the bird wheels round and takes a long flat glide to the left, of duration 100/(72 sin 1 4°), or 56 seconds, down to the surface of the sea, where it again wheels round and proceeds to repeat the whole cyclic process every 60 seconds But it is to be noticed that each brief ascent of the bird takes place much farther down-wind than the last ascent, so that the bird may drift rapidly southward through the seascape, even nearly as rapidly as the headway of the bird plus the velocity of the wind at a height of about 50 feet, and that may easily be so great a total as 60 to 70 miles an hour It becomes, therefore a debatable point to consider how much or how little the bird may depend on *this* particular cycle of soaring, and yet preserve its position in the seascape, outside a headland or bay or close to a slow ship, so well as it sometimes does

But the fact which just for an instant can occasion a little surprise, is that the bird need not turn round, but may continue northward against the wind It may not soar higher, and it cannot even continue to glide level without losing headway, but it may, and indeed must direct itself steeply downwards to proceed at steady headway The negative value of α that satisfies formula (1) is 42 degrees, and at that slope the bird may descend 100 feet in 100/(72 sin 42°), or 2 1 seconds, after previously taking the 4 0 seconds to ascend at the slope of 20 4 degrees The procedure of the bird is now to execute a series of deep hollow swoops, northwards against the wind, pointing down at 42 degrees for 2 1 seconds and then up at 20 4 degrees for 4 0 seconds, the whole swoop being then repeated every 6 1 seconds The progress northwards is at the rate of (2 1 × 72 cos 42° + 4 0 × 72 cos 20 4°)/6 1 or 62 5 feet per second, or 43 miles an hour relatively to the air at the mean 50-foot level, so that to the extent that the wind at the 50-foot level is less than 43 miles an hour the bird can actually advance northwards through the seascape against the wind When it has so progressed for a mile or so in a number of swoops, *then* it may wheel round and take the pleasant long flat glide with the wind, and continually repeat such a grand combination process in a way to keep to one locality in the seascape

Nevertheless, the above presents the case as a pure case, artificially arranged so, and of necessity, for the purposes of calculation and abstract reasoning The strata of the actual wind must refuse to shear smoothly over one another without breaking into a turbulent state and especially into small and large eddies rotating around horizontal cross-wind axes These turbulences offer other opportunities of soaring, that are also to be expounded in the form of pure, abstract cases, and so great an artist as the albatross may not be wholly negligent of, and unthankful for, such opportunities, although *stratified structure-gust soaring* (if that name be allowed) may be the bird's great favourite The name "stratified structure-gust soaring" may be understood to refer to the fact of the wind being supposed to be stratified in its velocity structure, and also to the fact of the bird soaring by a head gust that is present, not as an actual acceleration of the air particles themselves, but by reason of the bird judiciously crossing the velocity structure of the air in such manner as to develop for itself a useful "structure-gust" effect This term was similarly proposed in 1913, in the book "Aeroplanes in Gusts and Soaring Flight," by the present writer

Now, so far as an albatross can soar in the way observed and described, there would seem little reason why a small and fast aeroplane, manned by an interested pilot, should not immediately soar to some extent in a like manner, by facing the wind blowing

over the sea or a large lake or possibly over a large flat plain, and quickly swooping down and up close to the surface—pointing down at about 40 degrees and then up at about 20 degrees, or at about half these angles if the propeller is allowed to be of some assistance. At suitable intervals it may take the long flat glide with the wind. In any case, however, independently of soaring, aviators may have need to consider that in starting off against the wind it may be convenient to point up at an angle approaching 20 degrees and so endeavour to continue; and in the event of being compelled to point their aeroplanes down they may have need to be prepared for the lowest strata of the air near the sea seeming to refuse proper support. Indeed, some experiences of this character already seem to confirm M. Idrac's observations of the wind near the surface of the sea.

S. L. WALKDEN.

London, June 8.

Science and Intellectual Freedom.

IT is with considerable amusement that I have read the collection of opinions published in NATURE upon the recent action of the State of Tennessee in forbidding the teaching of what we believe to be the established facts of human evolution in schools supported by public funds. There is an admirable undertone of contempt and condemnation in most of these contributions and a scorn that spreads at moments from Tennessee and Oklahoma to things American in general. Yet the British Government is at the present time in an almost parallel position to the Government of the benighted State of Tennessee in regard to a closely similar body of knowledge. At present if a medical officer of health or a health visitor in public employment gives information about contraceptives to a patient publicly paid for, he or she is liable to dismissal, and several cases of dismissal have occurred. The Minister of Health in both the previous and the present governments has refused to allow these officials the freedom at their discretion and with all circumstances of privacy, to give this sort of information to adults asking for it from them. There is no question of propaganda here or of forcing this kind of knowledge upon those unwilling to receive it. But British adults of the poorer classes wishing to know this much about their own bodies and to have this much of control over them, cannot get it in a private, seemly and proper manner from their publicly supplied and duly qualified medical advisers, but must resort to the one or two overworked privately supported clinics that exist, or to furtive expedients, to quacks and underhand and dubious sources of information. This is mainly a concession made by these successive Ministers of Health to the Roman Catholic vote. They plead that taxpayers of that persuasion might object to their money going to supply such knowledge to people with different views. But that is precisely the argument of the Tennessee legislators. They plead that a respectable body of old-fashioned Christians regard the doctrine of human evolution as a dangerous and sinful heresy and that therefore they may object quite reasonably to their money being spent upon its diffusion.

In all these matters I am for open and accessible knowledge and free and frank discussion everywhere in Britain as in Tennessee, but I submit that the *élite* of British science have no case against the State of Tennessee until they have done something to put our own house in order. Perhaps later you will give us another Supplement of a rather wider scope and raise the whole problem of intellectual freedom in relation to these modern publicly endowed systems of education in which the teacher is at any time liable to the irruptions and direction of the government and the politician. The bulk of our educational organisation at every stage and much of current research could not exist without State support and subsidies and the riddle of receiving maintenance without sacrificing freedom is a very fine and subtle one, which is not disposed of by damning Tennessee.

H. G. WELLS.

Easton Glebe, Dunmow,
Essex, July 16.

On the Presence of a Perennial Mycelium in *Pseudoperonospora Humuli* (Miyabe & Takah.) Wils.

IN a recently published article (*Annals of Applied Biology*, 12, p. 121, 1925) we have given a description of the downy mildew of the hop (*Pseudoperonospora Humuli*), a disease until recently unknown in England or in Europe, but now beginning to cause considerable damage in Kentish hop-gardens. The object of this note is to record certain new facts, of scientific and economic importance, which have been lately discovered in the life-history of this fungus.

The occurrence of diseased, stunted "spike"-like shoots arising from the root-stock of the hop so early as April led to a search being made for mycelium in the perennial underground parts. Examining during May one- and two-year-old diseased nursery "sets," by means of hand-sections stained with azo-blue, the existence of mycelium was ascertained in the pith and cortex of one-year-old portions of the "crown." The mycelium was not traced lower than this, but there is a possibility that it may be even deeper-seated. The presence of a hibernating mycelium in certain members of the Peronosporaceæ has already been recorded; in the case of the beet mildew (*Peronospora Schachtii*), by Kuhn in 1873; and in the onion mildew (*P. Schleideni*) by Dr. P. A. Murphy, in 1921 (NATURE, 108, Nov. 3, p. 304).

The alarming feature of the outbreaks of the hop downy mildew which are now taking place for the first time in hop-gardens in England is their epidemic nature and the early attack on the young stems ("bines"). Under the influence of the disease the tips of normal, healthy-looking bines, when these are 5-7 feet high, are suddenly arrested and transformed into a tufted or "spike"-like growth. As many as seventy per cent. of the hop-plants ("hills") in a garden may show the disease, and in some cases all the stems ("bines") trained up may prove to be diseased. While in the case of the shorter basal "spikes" the mycelium appears to be continuous throughout their length, this is not necessarily the case with the longer diseased bines, where the mycelium may be absent from certain nodes, with the result that healthy lateral shoots may be produced. Within the stunted "spike" of the longer stems the mycelium is present close behind the growing point of the apical bud and extends along pith and cortex commonly for a foot or more. The extent of the mycelium within the pith is marked by a brown discoloration; in internodes where the pith is hollow the fungus has been found to accumulate hyphæ which form a lining for the hollow cylinder. These hyphæ give rise to oogonia and antheridia, and the pith eventually becomes lined with masses of oospores. These oospores, which hitherto have been reported as occurring only in the leaves, have been found in abundance within stems so early as mid-June, and in one case in May. The occurrence of oospores in "spikes" renders imperative the destruction of the latter, when they have been removed by the grower.

In several cases it has been found that the mycelium in the cortex penetrates the epidermis and produces masses of conidiophores on the outside of the stem, which is rougher and coloured light-brown in those areas

On rare occasions a few conidiophores with conidia are found projecting into the pith cavity, in regions where formation of oospores is taking place

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Seed Dissemination of Nematoda

RECENT American workers have directed attention to the fact that Nematoda attacking certain plants are regularly disseminated in the seeds of their host

Whilst working on the relation of *Tylenchus dipsaci* Kuhn to one of its common host plants, namely, the oat, the occurrence of various Nematoda between the pales was observed Some correlation between such occurrence and a relatively poor development of the plant was also observed Various genera were identified, notably Tylenchus and Diplogaster, but the forms most commonly present were small larvæ so immature that accurate identification was not possible

Seeds known to be so infected and germinated under sterile conditions were, on later examination, found to harbour numbers of Nematoda of a species of the genus Cephalobus It seems, therefore, that dissemination in seed must be accepted as one at least of the normal methods of spread of the species in question Special interest attaches to this, for so long ago as 1906 Marcinowski showed that *Cephalobus elongatus* Sch was capable of injury to cereals, while Steiner has recently shown that the species *C sub-elongatus* Cobb may cause damage to the foliage of Phlox plants

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Observed Stark Effect Patterns in Helium

RECENTLY I have taken photographs of the Stark effect in helium which show quite clearly that the parhelium principal series line λ3965 has the pattern 1/1 (*i e* one component plane polarised parallel to the field, and one component circularly polarised perpendicular to the field) instead of the complex pattern 3/3 reported by T Takamine and N Kokubu (Mem Coll Sci, Kyoto, 3, 275, 1919) With improved experimental conditions, the new spectrograms prove that the simple displacements (1/1) reported by Stark and Nyquist for the members of the sharp and principal series are correct, and that the complex analyses claimed for some of these lines by Takamine and Kokubu were due to insufficient control over the Lo Surdo tube

A further point of interest is the appearance of a new weak perpendicular component of the parhelium combination line λ4384 In a field of 40 kv/cm this line has two components with wave numbers 22832 8 and 22839 0 This completes the pattern 2/2 for all members of the combination series $2P - mP$, $m = 4$ to 7 inclusive

Two examples of the pattern 2/3 have been brought to light in this investigation (1) The parhelium diffuse series line λ4922, in an electric field of 45 kv/cm, is found to have components with the following wave numbers

par 20293 9, 20295 8, densities 4, 5
perp 20293 9, 20295 8, 20302 3, densities 1, 2, 7

(2) The accompanying photograph (Fig 1) shows two orthohelium lines in electric fields As usual, a double image prism has been used to separate the parallel (upper) and perpendicular components At the top of the photograph there appears to be but one line—the diffuse series doublet λ4472 Since this is not resolved, the analysis shown here is assumed to be that of the stronger component In high fields, near the cathode, this line is deflected toward the left and split into two components A very faint line in the normal undisplaced position is due to stray light not emitted by the main source It is useful as a line of reference Immediately at the right may be seen the combination line $2p_1 - 4b$ making its appearance in a very low field (Harry Nyquist, *Phys Rev*, 10, 226, 1917) This line has the pattern 2/3 Most of the components are over-exposed in order to show the new perpendicular component The insert is a photograph of the perpendicular component of He λ3965 in fields up to about 50 kv/cm

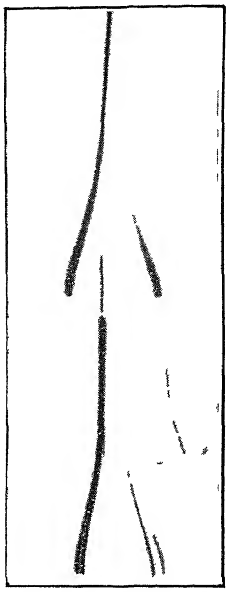

FIG 1 —Orthohelium group λ4472 in electric field, and, on right, perpendicular component of He λ3965

These patterns for helium series lines are identical with those claimed for the corresponding hydrogen fine structure components in the theory given by H A Kramers (*Zs f Phys*, 3, 199, 1920)

J STUART FOSTER

McGill University, Montreal, Canada,
June 15

The Word "Australopithecus" and Others

WHEN Dr Bather hints (NATURE, June 20, p 947) that the word "Homosimiidæ" is not correctly compounded, he probably means that the compounding stem of *homo* is *homi-*, as in the Latin *homicida* But "Australopithecus" is also incorrectly formed, for the compounding stem of *australis* is *australi-*

Why will people venture to invent new names without consulting an etymologist? Neglecting this precaution, even a good classical scholar may flounder

F J ALLEN

8 Halifax Rd, Cambridge,
June 28

Cancer Research

REFERRING to the recent work on cancer by Dr W E Gye, the statement in NATURE of July 18, p 107, that Dr Gye was "assisted by Mr J E Barnard and Dr J A Murray," which has also appeared elsewhere, attributing to me a direct participation in the work of Dr Gye and Mr Barnard, requires correction

The very generous acknowledgment in Dr Gye's paper in the *Lancet* sums up all my association with his researches I should be lacking in candour if I permitted the suggestion of a closer collaboration to pass without a disclaimer

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The Natural Classification of Ferns as a Study in Evolutionary Methods [1]

By Prof F O Bower, F R S

IN the light of evolutionary theory the object of a natural classification of living things has ceased to be a mere catalogue, useful primarily for the recognition and accurate designation of genera and species Such a classification is now understood to express, at least in some degree, the evolutionary relations of the organisms classified, though still it may be far from fulfilling its theoretical end Kin will take place near to kin, and if the relationships be truly apprehended, the whole grouping of different forms will be such as to seriate them, so that those earlier in historical origin should precede those of later appearance The series would lead from presumably primitive to presumably derivative types But naturally a simple linear series, such as any catalogue must show, cannot adequately portray the highly complex relations of any well-represented group Moreover, such relations are apt to be so obscured by the extinction of intermediate forms that, though this might at first sight appear to simplify the problem, it at the same time increases greatly the difficulty in recognising affinities, and often makes any definite opinion on relationship highly problematical

In the face of such drawbacks many are disposed to regard the problem of natural classification as hopeless and the results attained may appear to be mere expressions of personal bias Moreover, the divergences of opinion expressed by different experts in the investigation of the same group are sometimes so great as to forfeit confidence in their methods The critic may then conclude that the materials available for inductive argument are too disconnected, and positive data too deficient to lead to any satisfactory result However true this may actually be, the demand may still be made that at least the classification adopted for any given group shall not violate, but rather accord with such settled conclusions of affinity as are founded upon an adequate field of observation comparatively treated The wider the area of observation the more probable will it become that the grouping based upon it will be correct This is indeed the theoretical basis of any classification that can be regarded as natural

Many groups of plants, comprising at the present day numerous genera and species, appear so highly standardised as to give little scope for such treatment The differences that they show are relatively minute, while in the absence of a consecutive geological record of their past history it may appear impossible to rank those differences in any probable phyletic sequence This is the condition of the Angiosperms as a whole consequently little headway has yet been made in their phyletic grouping while opinions are by no means in full accord as to what characters are to be held for them as primitive, or as derivative But it is otherwise with the Filicales There are many thousand species of living ferns, distributed in more than a hundred well-marked genera The range of variable characters which may serve for their comparison is wide while the class is represented with a more or less consecutive history back to the Palæozoic age These facts at once suggest that the class of ferns would provide material suitable for a searching experiment in the methods upon which a natural classification may be based

We have seen that in order to obtain a stable result it is desirable to extend the comparison over a wide area of fact The weakness of early groupings for the ferns has been that the area of comparison was too narrow It involved chiefly the external form, and the sorus and sporangia, while anatomy and the characters of the gametophyte were scarcely used at all, nor was the palæontological evidence taken into account Though naturally the features of the sporophyte, being more elaborate and also more varied, still take the prior place, all variable features should be used In respect of each the limits of variability must be defined, and the question considered whether one extreme or the other should be regarded as primitive Here a comparison with related fossils becomes important, and often indeed it is decisive, as in the conclusion that the Eusporangiate type is more primitive than the Leptosporangiate

There are already twelve criteria of phyletic comparison in use in ferns, and others may probably emerge later They are (1) external form of the shoot, (2) architecture and venation of the leaf, (3) initial constitution as shown by apical segmentation, (4) the vascular system, (5) dermal appendages, (6) position and structure of the sorus, (7) indusial protections (8) character of the sporangium, (9) spore-output, (10) morphology of the prothallus, (11) the position and structure of the sex-organs, (12) embryology In respect of all of these, but naturally in varying degree, it is possible to distinguish a type that is held to be relatively primitive, from that which is derivative, moreover, so far as comparison with related fossils is possible, the palæontological sequence may be taken as a check upon conclusions, since its data are drawn from the most positive source that is available in comparative morphology Further, it is found in the Filicales that the results of comparison, thus checked, run substantially parallel in respect of the several criteria upon which the comparisons are based Exceptions do as a matter of fact occur, but the marked preponderance of parallel progression in respect of features so dissimilar as, for example, sporangia and antheridia, dermal appendages, conducting tissue, and spore-output, gives added confidence to the application of a comparative method so broadly based and so adequately checked

From materials such as these it has been possible to draw up a verbal specification of a type which would embody all the relatively primitive features, and thus it might be visualised as a common archetype, which should represent something like that source from which we may presume that the class of ferns may ultimately have sprung The specification would comprise an upright radial shoot, perhaps rootless, and forking equally if it branched at all, the distinction of axis and leaf ill-defined, the leaf, if recognisable as such, long

[1] Substance of three lectures delivered at the Royal Institution, May 21, 28, and June 4

stalked, forking, with its segments narrow, and separate one from another , the general cellular construction robust, and without a single initial cell in the several parts , the conducting system consisting of simple tracts with solid xylem-core , the surface bare, or with simple hairs , the sporangia solitary, distal, and relatively large , the spores numerous in each sporangium, and all alike , and the opening mechanisms of the sporangia not highly organised Naturally, since the prothalli are not as a rule preserved as fossils, little help is derived in checking the comparisons of the gametophyte , and it is omitted in the specification, which applies only to the sporophyte

If the above specification be compared with the actual features displayed by the fossils of the Rhynie Chert, so beautifully revealed by Dr Kidston and Prof Lang, it will be seen that a substantial similarity exists It is not suggested that any one of the Rhynie fossils itself represents an ancestor of the ferns What does appear is that among the vegetation of the earliest adequately known land flora, there existed plants which shared those leading features of the sporophyte which wide comparison of the ferns, living and fossil, has led us to regard as primitive for them

Starting from such a source, which is not, as a matter of fact, far removed from what is actually seen in the extinct Botryopterideæ, a general advance may be traced through the ages, culminating in the modern Leptosporangiate ferns The leading features of progression consist in departure from the upright habit, and equal dichotomous branching of axis and leaf , progressive webbing of the leaf-segments and adoption of netted venation , elaboration and progressive disintegration of the conducting tracts , substitution of flattened scales for simple hairs , transit of sori from distal or marginal to superficial positions , passage from the simple sorus with sumultaneous sporangia, to a gradate or a mixed succession of them , elaboration but often also a final abortion of indusial coverings , a progressive diminution of the individual sporangium, with corresponding increase of their numbers, and of the precision of their ejaculating mechanisms , finally, a diminution of the spore-output from each, from many thousands to definite numbers such as 64, 48, 32, 16, 8, or even in extreme cases to a single one These progressions run substantially parallel, and accompany a progressive fining down of structure from the grosser Eusporangiate to the more delicate Leptosporangiate type

Such evolutionary progression, traced by wide comparison in respect of many criteria, and checked by reference to the palæontological record, which in the ferns is both ample and consecutive, may be expected to yield material for argument as to the methods of evolution In particular it makes possible views involving the essential factor of geological time, so often omitted or wholly forgotten in the evolutionary discussions of the moment Between the Devonian Period and the present day there is spread out before us the whole drama of fern-evolution, including the changes profusely polyphyletic, embodied in the previous paragraph We may fix our attention especially upon two marked features upon which the series throws light, namely, the slide of the sorus from the margin to the surface of the widening leaf, and the progressive elaboration of the vascular tissue with increasing size of the part it traverses Evidence of progress in respect of both of these may be traced not only in the race, where the results are found to be hereditarily fixed, but also in some degree in the individual life, where they are seen to be still plastic

The shifting of the sorus from the margin to the surface of the expanded leaf gives the biological advantage of protection from direct insolation during development In some families, such as the Marattiaceæ, Gleicheniaceæ, and Cyatheaceæ, and in Todea, it happened early in geological history, and became hereditarily fixed with a high degree of uniformity In others, as in the Schizæaceæ, Hymenophyllaceæ, and Dicksoniaceæ and in Osmunda, the primitive marginal position was retained In some the transition from a marginal to a superficial position may be seen actually in progress, as in the Dennstædtinæ and Pteridaceæ The transition may be held as adaptive, and the steps of the adaptation may actually be followed in the individual development in such genera as Dennstædtia or in Pteridium Such facts, the details of which will be found fully described elsewhere,[1] suggest that a widespread and polyphyletic phenomenon of adaptation is before us It may be described as a slide of the sorus from the margin to the lower surface, which is clearly a biological adaptation The genera quoted show that it is actually progressive in the individual development The evidence suggests very strongly that there has been a widespread inheritance of a character primarily acquired by biological adaptation in the individual, and that it has become fixed as a heritable character not once only but repeatedly The whole period of geological time from the Devonian onwards has been available for the process, which has happened in some phyla early, in others late, and is in some individual living ferns caught actually in the plastic or nascent state

A similar argument may be advanced in relation to the progressive expansion and disintegration of the conducting tracts in ferns, which appears to be closely connected with the limiting factor of size, and the adjustment of the proportion of surface to bulk in an enlarging organism The progressive expansion, elaboration, and even disintegration may be traced in perfection in the ontogeny of such ferns as *Gleichenia pectinata*, *Pteris podophylla*, or *Plagiogyria* The elaborated result has become hereditarily fixed with characteristic differences in detail in many distinct races of ferns The resulting structure provides features sufficiently stable to serve for far-reaching comparison

Such arguments and such conclusions will of course be met by the objection that they traverse the doctrine of the non-inheritance of acquired characters But it needs to be stated that the structural basis for this doctrine, however it may apply in animals, has no validity in the plant-body In them there is no early segregation of somatic from propagative cells These remain indistinguishable until a late state of individual development In the absence of such structural segregation for plants, and in view of the positive evidence above advanced, we appear to be justified in concluding that in plants the distinction between fluctuating variations and mutations is not absolute

[1] Bower F O, 'The Ferns,' vol 1, Cambridge University Press, 1923

In other words, characters that are seen to be adaptive in the individual life are apt to become hereditarily fixed, and in the progress of geological time this has happened repeatedly

The impressive address of Sir Francis Darwin as president of the British Association in 1908 in Dublin should be recalled The observations and conclusions relating to ferns which have been acquired in recent years appear to be susceptible of interpretation only through some form of mnemic theory, such as he there disclosed It is not only in the moral world, but perhaps also in the physical frame of living things that the methods of the importunate widow produce their result, and this will become the more plain where, as in the study of the ferns, the whole period of geological time from the Devonian Period onwards is available for the method to produce its structural effect In recent discussions, too much stress has been laid upon the failure or success of laboratory experiments, which have extended at most over only a few years Here in the ferns we see evidence derived from experiments carried on naturally and continuously since the Palæozoic age and they indicate that adaptive characters are heritable Preference should surely be given to those results which appear without any narrow time-limit These show that, in the language of the mnemic theory, engrams are imprinted upon the propagative cells The impress of an engram in ordinary life may be, and probably is, a relatively rare event The difficulty in producing satisfactory evidence of the inheritance of acquired characters in brief laboratory experiments in itself indicates a high resistance of germ-cells to their reception But prolonged comparative study of ferns, with their long geological history taken into account as a checkupon its results, appears to justify the view that in them the difference between fluctuating variations and mutations is not absolute It indicates rather that characters acquired by adaptation in the individual life may become hereditarily fixed if secular time be available

The International Research Council

THE International Research Council held its third meeting at Brussels in the Palais des Academies on July 7 and the two following days The first meeting took place six years ago, in July 1919, when the statutes of the Council were adopted, and steps were taken to form the Unions of Astronomy, Geodesy and Geophysics, Chemistry, Mathematics, and Radiotelegraphy The second meeting was held in July 1922, when some additional countries were invited to join the Council, and the formation of the Unions of Geography, Physics, and of the Biological Sciences was agreed to

Since the second meeting nine countries have joined the Council, so that the number of adhering countries up to the present time is twenty-nine, to which Latvia and Tunis have now to be added, having been admitted at this meeting thus the total membership is now thirty-one Of this total membership, however, only seventeen were represented on this occasion at Brussels, namely Belgium, Czechoslovakia, Denmark, Egypt, France, Great Britain, Holland, Italy, Japan, Morocco, Norway, Poland, the Union of South Africa, Spain, Sweden, Switzerland, and the United States The votes assigned to each country depend on its population, and the total number of votes controlled by the delegates was 52

It was reported to the Council that the former International Seismological Association had been dissolved, with the assent of all the countries who were members of the Association It was proposed that the Council should accept responsibility for such of the property of the Association as had been taken over, and this was approved The work which this Association formerly carried out is now undertaken by the Section of Seismology in the International Union of Geodesy and Geophysics

The most important business that was before the Council related to certain modifications of the statutes which had been proposed by Australia, by Denmark and Holland, by Sweden and by Switzerland All of these, though differing slightly in form, had for their object the removal of the restrictions which now limit the membership of the Council and the Unions related to it to those nations who joined in 1918, and others who have since been invited to join or have been elected under the existing statutes, these embrace only the Allies and neutrals of the War period, 1914–1918, the Central Powers being excluded At the second meeting of the Council in 1922 a proposal was made to remove this restriction, but at that time it was not considered advisable to amend the statutes, and no action was then taken

The procedure to be followed in modifying a statute lays down that " no change shall be made in the terms of the Convention except with the approval of two-thirds of the votes of the adhering countries" According to the president's calculation, the rule required 53 votes, so that even if a unanimous vote of all the delegates present had been obtained for any of the proposals, it would not have effected a valid change of statute Thus although there was a majority of votes in favour of the changes proposed by Holland and Sweden, the statutes could not be altered The situation, therefore, must remain as it was until the Council at another meeting comes to a different decision on this question, or agrees to modify the statute which requires a two-thirds majority of the votes, not merely of the countries present but of all the countries which belong to the Council In the meantime the Executive Committee may by correspondence obtain a more representative opinion from all the adhering countries, for the statutes permit a country not represented by a delegate to vote by post

The further proposal, submitted by France and Belgium, that membership of the League of Nations should qualify a country to be elected was not generally acceptable, and was therefore not adopted

This result is in every way most unfortunate for international science not only does it postpone the time when the Research Council will be truly international, but it also raises the question whether, as things stand, it will be possible to carry out the modification of any statute until the end of the present Convention in 1931 A full attendance of all the countries belonging to the Council at any meeting can scarcely be counted upon, though the votes of all of

them have to be taken into account in determining the two-thirds majority, so that a small group of dissentient votes may suffice to prevent a resolution being carried, or, as in the present case, a unanimous vote of those present may be insufficient to obtain the necessary majority The serious inconvenience of this state of things was emphasised by several of the delegates at the present meeting, and the Executive Committee was requested to consider the situation, which must increase in difficulty as the membership of the Council is more widely spread over the world, with the view of suggesting a remedy

The Council was not in favour of a proposal to rescind a resolution adopted at the meeting in 1922 requiring a country to join the Research Council before becoming a member of a Union

A Committee which had been nominated provisionally by the Executive Committee in order to study the relations between solar and terrestrial phenomena was formally appointed by the Council for a period of three years, with power to add to its membership The Committee will enter into communication with scientific men who are interested in the subjects to be studied by the Committee, especially those of countries which are not represented on the Committee The constitution of the Committee is Prof S Chapman (chairman), Prof G Abbetti, Dr C G Abbot, Dr C Chree, M H Deslandres, General G Ferrie, Dr C E St John, Dr G C Simpson, and Prof C Stormer The Committee held several meetings at Brussels on the present occasion The Council had also before it a proposal from the International Mathematical Union advocating intimate co-operation between the Union and the Committee of Intellectual Co-operation of the League of Nations As probably affecting other Unions also, the proposal was referred to the Executive Committee of the Council for consideration and report

The period for which the president of the Council, M E Picard, had been elected having come to an end, his re-election was proposed by Prof Lorentz and was unanimously agreed to Dr G E Hale and M Lecointe being unable for reasons of health to serve on the Executive Committee, Dr V Kellogg and M P Pelseneer were elected to fill these vacancies

The Union of Pure and Applied Physics, and that of the Biological Sciences, held meetings at Brussels during those of the Research Council In the Union of Physics the desirability of full internationality being attained at the earliest possible date was urged, and a resolution to this effect was passed unanimously

Industrial Chemistry at Wembley

THE visitor to the British Empire Exhibition who takes it *au sérieux* will find a plethora of good things to stimulate his mind, and if his bent is towards science or its applications he will revel in the exhibits of the Government Pavilion and in many of the attractions of the Palace of Industry In the latter the signs and portents of chemical enterprise should convince him that the days of "dogmatic slumber" are fast disappearing, and that although British chemical industry cannot compare in magnitude with such industries as engineering, mining, shipping, and textiles, they are nevertheless of equal fundamental importance As in 1924, the chemical exhibits have been organised by the Association of British Chemical Manufacturers, and the same commanding position in the Palace of Industry has been utilised

Comparing the chemical section with that of last year, the visitor will notice the same excellent lay-out, though he may regret the absence of exhibits from a number of well-known manufacturers This absence does not, however, seriously impair interest, and in some ways is an advantage, because undue multiplication of similar exhibits is avoided, and there is more space available for effective display On the other hand, the presence of rather an excessive number of vendors of "cures," perfumes, hair-washes, and other proprietary toilet articles is apt to confirm the man in the street in his prepossession that chemistry begins and ends with pharmacy Another noticeable absence, both this year and last year, is that of chemical exhibits from the Dominions Overseas Nowhere in the Exhibition do we find any tangible evidence that our sister nations are striving to realise their war-time aspirations of industrial independence and of security against physical aggression through the medium of a well-organised and effective chemical industry

Although many of the exhibits are the same as those shown last year, there are a number of interesting novelties The exhibit of Messrs Burroughs Wellcome and Co is a model of clear and attractive presentation, and its educational value is very high Not only are medicinal and photographic chemicals displayed in artistic form and, where possible, in logical array, but concise information is also given concerning raw materials, methods of extraction, and preparation by synthetic methods, manufacturing operations are outlined, intermediate products are described, and miniature models of apparatus are exhibited To attract the public there are crystals of various substances illuminated by coloured lights, and there is a very interesting display of historical relics—medicine-chests and first-aid outfits—carried by famous explorers, as well as dioramic views of the scenes of their activities

Acids, alkalis, and other main products of the heavy chemical industry are so familiar that it must be difficult to devise new modes of display Messrs Brunner, Mond and Co, with their associated firms, have overcome this difficulty, partly by means of an attractive setting, and partly by exhibiting some up-to-date applications of well-known substances Thus a number of new uses have been found for sodium silicate (of various composition), which has long been used in large quantities as a filling for soap (though it is said to have a slight detergent action) When mixed with powdered limestone it is now successfully used for hardening the concrete surfaces of roads, and the soft porous chalky limestone, which has hitherto been found useless for road-construction, has now found a valuable application The mixture is sprinkled on to the prepared surface and then worked in with a soft broom Three coats are applied, and the surface of calcium silicate so produced is more durable and more free from dust than surfaces made with the aid of coal-tar Messrs Brunner, Mond and Co are also showing specimens of "grey pressed bricks," made of calcium silicate, which, though relatively heavy, are stronger and much less

pervious to water than common bricks, whilst their prepared surface renders unnecessary the use of plaster Sodium silicate is coming into use as a means of preventing corrosion of water-pipes and cisterns, and of enabling aluminium utensils to withstand the action of hot solutions of soda It is also used as an adhesive Calcium chloride, a heavy chemical which for long awaited an adequate market, is used, *inter alia,* for spraying rubble tennis-courts to prevent the rising of dust

The firm, Synthetic Ammonia and Nitrates, Ltd , shows a small case containing specimens of the products made in the nitrogen factory at Billingham-on-Tees These consist of calcium nitrate, sodium nitrite, ammonium nitrate (not yet marketed), ammonium sulphate, and " agricultural chalk," which is calcium carbonate containing two per cent of ammonium sulphate In view of the enormous potential importance of this industry, the exhibit is disappointing The mere display of products, most of them very familiar, gives the public no idea of the nature of the nitrogen problem and how chemists in all civilised countries are trying to solve it , and it should be possible to give the student and the technical man satisfying information without disclosing vital secrets of manufacture

An interesting feature of the Brunner-Mond display is a continuous automatic-lantern exhibition depicting bird's-eye views of factories, the loading and unloading of goods, methods of transport, offices, etc , connected with this firm's world-wide activities Messrs Chance and Hunt, Ltd , are showing, in addition to their staple products, specimens of ferrous chloride, which is now used in making jointless magnesite flooring The Castner-Kellner Alkali Co has a small exhibit relating to the use of liquid chlorine and of chlorine derivatives of ethane and ethylene, bleaching agents, etc , whilst Electro-Bleach and By-products, Ltd , makes a special point of its sesquicarbonate of soda, which is a very concentrated form of soda for cleaning and other purposes

Messrs Albright and Wilson, Ltd , well known for their manufactures of phosphorus, show interesting exhibits relating to the fire-proofing of wood and the preservation of stone By means of the " Oxylene " (secret) process, owned by the Timber Fire-proofing Co , Ltd , of Market Bosworth, wooden safes and their contents can now be protected from the effects of exposure to high temperatures A deal fire-proof door is shown, one side of which became covered with adherent non-conducting charcoal on exposure to flames at a temperature above 900° C , whilst the other side barely became hot The merits of Prof A P Laurie's " silicon ester " as a means of preventing decay of building-stone are effectively indicated by specimens of treated and untreated materials " Silicon ester " is made by the interaction of alcohol and silicon tetrachloride, and it acts by depositing silica in the pores of the stone, thereby strengthening it but not affecting its permeability One of the chief attractions in the stand of the United Alkali Co is an educational exhibit of " intermediates " derived from coal-tar, so executed as to bring out their genetic relationships The Salt Union, Ltd , shows that it is moving with the times by displaying a table-salt which, as the name " Salodine " suggests, contains an iodine compound , and the British Cyanide Co , Ltd , exhibits a new colourless and odourless synthetic resin, made from thiourea, which is well adapted for making insulating materials and moulded articles like cups and saucers

This year the dyestuff-makers have largely discarded strictly technical exhibits, and have co-operated in presenting artistic displays and colour schemes Instead of being met with the usual array of bottled products, the eye is at once attracted by two large tents, with revolving tops, and a long corridor, all draped with coloured fabrics Around are displayed articles, from carpets to candles, coloured with British dyes Fine chemicals are well represented by Messrs A Boake Roberts and Co , the Graesser-Monsanto Chemical Works, Ltd , the Clayton Aniline Co , Ltd , Thomas Tyrer and Co , Ltd , B Laporte, Ltd , and a number of others In the exhibit of the first-named there is a good model of a three-column distilling plant by Messrs Blair, Campbell and McLean

Our two largest gas companies are, as usual, to the fore with luxurious displays, and there is an attractive co-operative exhibit by tar-makers of a rustic scene with an inn, garden, bridge, a tree with mechanical singing-birds, and a country road made up with " Tarmac " Unfortunately, the recent report of the Standing Committee on Rivers Pollution has severely condemned the use of tar on roads, because the washings are toxic to fish, particularly when the road surface is broken up, and it enjoins the use of bitumen instead By way of counterblast there is shown in the scientific section a shallow tank containing live fish and plants supplied by water running over channels prepared with " specially refined " tar Although the conditions in the tank are scarcely comparable with those in a stream, the exhibit is ingenious and attractive to the passer-by

The scientific section is hidden away in the midst of the industrial chemistry exhibit Its position may perhaps be justified as indicating that scientific research is the " heart " of chemical industry The exhibit this year is devoted to educational exhibits relating to coal, salt, and food The coal exhibit is the most comprehensive, containing excellent models of plant, but all are good A small exhibit illustrating the properties, etc , of viscose and cellulose " silks," and that of some products obtained in the " Berginisation " of coal, increase the interest of this valuable section

In the above account it has not been possible to mention more than a few of the exhibits, but there are many more of a high order Those who are responsible for the success achieved during the two sessions will doubtless use the experience gained to do even better in the future The tendency, already shown, to find substitutes for " bottled " products should be encouraged , there should be more models of plant and apparatus, and—what is entirely lacking in the present exhibition—economic information conveyed in the form of charts and diagrams Those who stand for science in industry appreciate the fine efforts which so many chemical manufacturers have made in connexion with this exhibition , they would be even more appreciative if their thirst for knowledge could be assuaged by conversation with a few technical men who might be specially detailed to explain or demonstrate the processes and products displayed

Recent Researches on the Causation of Tumours

By Prof WILLIAM BULLOCH, F R S

A WEEK or two ago it was rumoured that remarkable additions had been made to our knowledge of tumours by Dr W E Gye, of the scientific staff of the Medical Research Council Instantly, almost every newspaper took the report up, some of them announcing with sensational headlines that the problem of cancer was solved and that the disease was due to a small germ Dr Gye's collaborator, Mr J E Barnard, F R S —a well-known scientist—was said to have secured photographs of the virus, and it was alleged that it had actually been cultivated What the real facts were, was only the property of a few, because the papers of Gye and Barnard were not published until some days later In the absence of details, a short note appeared in NATURE of July 18—the day of publication of Gye's paper—giving a general statement of the results said to be claimed, and so far as they were known It is now possible to write more fully and with greater confidence as a result of the study of the papers just published (*Lancet*, July 18)

Unlike many fantastic hypotheses which have been proposed to explain the cause of tumours, the present one comes from a scientific worker who has the very highest credentials and is known not only in England but also all over the scientific medical world Behind him is a wide experience, particularly of the kind of work on which he now reports, and he is known for his imaginative and critical powers, his sober judgment, and his high technical skill

William Ewart Gye is a man about forty years of age who graduated M D Edinburgh in 1913 and came to London to be assistant in the laboratories of the Imperial Cancer Research Fund about a dozen years ago His appearances in scientific gatherings stamped him at once as a quite unusual man, modest but efficient, full of scientific enthusiasm, but temperate and cautious in the estimate of his own work and that of others During the War he carried out very important investigations which cleared up several of the mysteries in the pathology of gas gangrene and lockjaw and secured him a post on the staff of the Medical Research Council When the Council inaugurated a scheme for the study of the unknown viruses of certain infective diseases, like distemper, Gye took his part, but early struck out on his own lines and, working by himself, has completed the research just published This work is of the greatest interest and, if confirmed, will be found to open up entirely new fields not only in what has hitherto been a veritable slough of despond—cancer—but also in connexion with many other diseases, of unknown causation, affecting man and animals Gye's paper in the *Lancet* is entitled " The Ætiology of Malignant New Growths " and is prefaced by a short paragraph quoted from a leader on the subject in the same issue It is unusual and often unwise to attempt to forecast what the ultimate value of a scientific paper will be, but the *Lancet* is of opinion that the two papers of Gye and Barnard " mark an event in the history of medicine " This may or may not be so, and we may note that the leader writer, in the next sentence, is more moderate when he states that they may present a solution of the central problem of cancer

The critical study of Gye's paper leads one to the conclusion that, if his results are confirmed by independent workers, he has made a discovery of the greatest interest and possibly of the highest importance to the well-being of man Before dealing with his data as presented, and as the subject is one which will be followed by scientific as well as non-scientific readers, it would appear well to clear the ground and state what was commonly accepted on the subject of malignant disease before Gye's publication, and it may be affirmed at once that but little of this knowledge has been controverted by his work

It is known that all races of man and animals are liable to the development of tumours or swellings—now called blastomata—which possess certain common and constant features No tumour has yet been seen that was not composed of some tissue of the body of the individual in which it arose For some unknown reason a tissue begins to grow in excess, and this growth, barring operation or accident, is unlimited in extent There is an infinite variety in the structure of tumours arising from different or even from one and the same tissue, and quite early an important line of demarcation was drawn on practical grounds between tumours that were clinically or histologically benign and those which were malignant and destructive of life The differentiation is, however, not always easy, or indeed always possible From remote times, two special malignant tumours have attracted interest on account of their deadly character These tumours—sarcoma and cancer—start in a particular tissue but early burst into other tissues Invading blood-vessels and lymph vessels, and being swept away in the circulating blood, the cells are carried throughout the body, halting in numerous backwaters to produce secondary tumours or metastases There is an irrefutable body of evidence, confirmed daily, that the secondary tumours are composed of cells which are the descendants of the cells of the primary tumour

The central problem of tumour formation is to find out what has caused this aimless growth of cells previously—so far as one can judge—perfectly normal It is this problem which Gye has attempted and is reputed to have solved There have, naturally, been many hypotheses on the subject of the cause of tumours, but two have gradually been accepted as the most probable In one, evidence has been sought experimentally and otherwise that the purposeless growth of the cells is due to some kind of chemical irritant acting on normal, or possibly abnormal, cells The other view, early held and long studied, attributed the cause of tumours, particularly malignant growths, to the action of some extrinsic parasite which, entering the body, stimulated the cells to unwonted activities Many parasites of microscopic size have been incriminated at various times during the last forty years, but none has fulfilled the test of tumour production experimentally and however much the study of malignant disease suggests an infection, the vast majority of those with special knowledge were compelled to reject a parasitic hypothesis on various grounds No parasite, not even that said to exist by

Gye, has by its inoculation caused by itself the development of a malignant or other blastomatous growth Further, there is a marvellous specificity in all growths whereby they copy, in every degree of variation, the tissue from which they arose Those facts forced investigators to the conclusion that, when one remembers the extraordinarily wide zoological range in which tumours occur, the cause is some deep-seated mystery connected with the processes of birth, growth, and decay of the cells of the body

In 1902, C O Jensen, of Copenhagen, discovered by accident a malignant tumour in a mouse, and worked it out so carefully that his paper has become a classic in the literature He failed to find any evidence of a parasite either in the original growth or in those transmitted by transplantation to other mice He showed that no growths followed the inoculation of tumour cells that had been crushed Since Jensen's time, many similar tumours have been studied and transmitted in an unbroken series of generations, and Jensen's statements have been confirmed over and over again Even before Jensen, several workers, among whom we may specially mention Bellingham-Smith and Washbourn in England, had shown that certain tumour-like formations were transmissible from dog to dog, but the exact nature of the growths was the subject of mush dispute

In 1910, a new, and, as it proves, highly important, work was published by Peyton Rous, of the Rockefeller Institute, N Y He found a tumour growing in the breast of a barred Plymouth Rock hen The tumour proved to be transmissible to other hens of the same setting, and in structure was regarded as a genuine sarcoma Transmission, at first, was not easy, but in the course of passage from one fowl to another the growth became more malignant in its effects and lethal within a few weeks In 1911, Rous made the further, highly important, discovery that when portions of the sarcoma were ground up and passed through filter paper, or even through a Berkefeld Kieselguhr filter, the cell-free *filtrate* contained some "agent" which could communicate the sarcoma disease to normal fowls No microbe could be seen in, or be grown from, the clear filtrate, and Rous left it an open question whether it was to be regarded as containing a living microbe "It is conceivable," he said, "that a chemical stimulant elaborated by the neoplastic cells might cause the tumour in another host and bring about in consequence a further production of the same stimulant"

The fact that the cell-free filtrates were capable of producing tumours was something quite new, but was soon found not to be unique, for between 1911 and 1913 Rous, in conjunction with Murphy, Tytler, or Lange, found two other fowl tumours transmissible in this way He also showed in the case of the first tumour ("Rous sarcoma I") that ultra-violet light rapidly destroys the activity of the sarcoma cells without destroying the filterable agent associated with them From irradiation experiments he made out that in the sarcomatous tissue there are apparently two elements capable of producing the growth One will withstand drying, the other will not The latter is the living transplantable cells, whereas the former is the tumour-producing agent

Coming to Gye's work, full credit is given to Rous for his admirable researches on the Rous sarcoma I It is with this tumour that Gye has mostly made his experiments His main thesis is that the "agent" is really a living virus This virus is incapable by itself of producing a tumour For the latter, there has to be the co-operation of a second factor—the "specific factor"—also incapable by itself of inducing a sarcoma, but which enables the living virus to attack the cells of the inoculated animal and transform them into malignant cells The impression gained from a careful perusal of Gye's paper is that he has more facts than he has yet divulged The experiments he has given us are carefully thought out and precisely described A medium—probably not the best one—is indicated in which he obtains "primary cultures"—"a term of convenience," he says, applied to the result of placing a fragment of tumour in the medium He found that in a tube of "primary culture" the supernatant liquor becomes infective, depending on various factors of which anaerobiosis is said to be the most important That the "primary culture" contains something living is suggested by the definite acid reaction which ensues when glucose, maltose, or lævulose are incorporated in the medium No such reactions occur in the presence of mannitol, lactose, or sucrose It is believed that the "agent" of the tumour diffuses out in the medium and that it disappears slowly (days)

Of fundamental importance for the support of Gye's views are his experiments on the action of chloroform on the tumour agent It had been previously shown by Rous that carbolic acid, toluol or chloroform destroys the power of the "agent" to induce tumours In a series of experiments, repeated, it is stated, with constant results, Gye shows that a "primary culture" incubated aerobically for three days at 37° C produced no tumour when injected into fowls The clear tumour filtrate thoroughly treated with chloroform was also incapable of inducing growth But the two inert fractions mixed together were found to produce typical sarcomata The interpretation given by Gye is that the chloroform-treated filtrate contains a labile chemical substance which in some way, unknown, renders the cells susceptible to the supposed virus, presumed to be present in the other fraction, which was incubated at 37° C for three days Gye's conception of a double factor was also supported by centrifugation experiments, for although it was not found possible to drive the virus to the bottom of the tubes spun at high rates, some concentration in special lined tubes did appear to occur Of the two factors necessary for the production of a Rous sarcoma, Gye believes that one is particulate and is therefore "probably a virus," the other, uninfluenced by centrifugation, being a chemical substance Since the supposed virus is incapable of producing a tumour, and since the tumours when they originate are specific, Gye admits that the "specific factor" must be the important thing when the action of the two is considered

Attempts were made to demonstrate that the "virus" actually multiplies in cultures In one experiment, a fifth subculture in direct line from a "primary culture" produced no tumour, nor did a chloroformed filtrate, but when the two were mixed,

tumours were produced and were lethal in twenty-three days. As each subculture represented a dilution of 1000 fold, the dilution of the matter in the "primary culture" would be 10^{15} if it had not increased.

These remarkable results with the Rous sarcoma I were followed up on other tumours of known origin and history. They included a spindle cell sarcoma "37/S," the Jensen rat sarcoma, carcinoma of mouse "No. 63," and a rat sarcoma known as "No. 9." Directly or indirectly, experiments with these tumours confirmed the results with the Rous sarcoma I. In each case the "specific factor" was the important one, the virus being less so. Thus a chloroform extract from Rous sarcoma was found to be incapable of producing the disease. A "primary culture" from mouse cancer "63" was also inert when tested on fowls. The specific factor of the fowl plus the "culture" from the mouse produced sarcoma in the fowl. This astonishing result was also obtained in the case of an adeno-carcinoma of the human breast. Inert "specific factor" from fowl tumour, plus inert "primary culture" from human tumour, caused sarcoma in the fowl.

That briefly and perhaps imperfectly represents the main results of Gye's published work. Of the proof of the "virus" he speaks guardedly. It is said to be "almost certainly a virus." The idea of two factors in the production of a disease is not a new one. It has, indeed, long been a commonplace of medical writers that the development of most diseases requires the co-operation of two sets of factors. On one hand, the organism within which the morbid process is to unfold itself must conform to certain conditions of structure and function. This is the so-called "internal" cause. On the other hand, some agent, the "external" cause, actually or functionally outside the organism, must exert an effect peculiar to itself, and a property of its own structure, upon the organism which is in process of becoming the seat of the disease. The revolutions in medical knowledge which came from bacteriological discoveries showed that for most infective diseases the specific agent was the external one. Thus the tubercle bacillus is the specific element in tuberculosis. In the case of tumours—if Gye's work is confirmed—it would appear that the specificity is not resident in the virus but in the "internal" cause—a new conception in connexion with infective disease. Gye's work may be the central point round which the cancer problem revolves. It is certainly a long way from the complete solution of tumour formation, although one must be frank and congratulate Dr. Gye on opening up a new field pregnant with possibilities.

With reference to Mr. Barnard's paper, this deals largely with the question of the microscopic examination of "ultra visible" agents. The agent chiefly described is the microbe of bovine pleuro-pneumonia, in which various morphological types are reproduced. Very little is said of the "virus" of Rous sarcoma and other tumours except that the same morphological types can be seen as occur in bovine pleuro-pneumonia. Attention is directed to the care necessary in excluding various "bodies" which are seen in uninoculated tubes. Finally, there is a combined note by Gye and Barnard. Their exact words may be here reproduced: "Our belief that the small bodies seen and photographed are the actual virus depends partly upon the fact that control uninoculated tubes of medium have been invariably blank and partly upon the correspondence between the microscopical findings and the results of experiments on animals. This correspondence—allowing for the real difficulties in both parts of the common task—has been so close that although final proof has not been attained we are convinced that our conclusions are sound."

Current Topics and Events

PRIOR to the War, there was in force an Order of the Board of Agriculture compelling the slaughter of cattle discovered to be suffering from tuberculosis of the udder and giving partial compensation to their owners for this compulsory action. This Order is about to be renewed for all cattle suffering from tuberculosis of the udder or from tuberculous emaciation, one-fourth of the market value if the disease is advanced, or otherwise three-fourths, being given to the owner. In these circumstances it will be interesting to ascertain how many are certified as suffering from advanced disease. From the same date the use of any cow for producing milk which gives tuberculous milk will be prohibited, and owners and veterinary practitioners are required to notify tuberculosis in cattle so soon as recognised by them. The last paragraph of the circular letter announcing the matter briefly summarised above adds somewhat deprecatingly: "The new Order represents the most that is practicable at the present time in the direction of securing the eradication of bovine tuberculosis, and in contributing to the production at the source of a milk supply free from bovine tubercle bacilli."

THIS statement on the official attitude in Great Britain towards bovine tuberculosis is commendably frank, and adequately reveals the weakness of the situation and the action—or is it merely "gesture"?—directed towards remedy. Disease is allowed to continue to become obvious to the farmer, and so obvious that he can no longer conceal it, or until a veterinarian is called upon the scene, and then the local authority—hereafter three-fourths of the money probably will be paid out of Exchequer funds—will pay three-fourths or one-fourth of the value of the condemned beast. There are some hundreds of herds of cattle in Great Britain from which tuberculosis has been eliminated by well-known and practicable scientific methods. Is it not likely that the resumption of compensation to the owners of beasts with advanced tuberculosis will delay the multiplication of tuberculosis-free herds? Moreover, is it not arguable that, in the interest of the many thousands of young children in Great Britain who annually are made victims of tuberculosis from drinking infected milk, it might be better to save the millions sterling which will be paid in compensation for disease which

has already in large measure done its lethal work, and in lieu of this belated attack on disease, to issue an Order demanding pasteurisation under strictly regulated conditions of all cows' milk not derived from a tuberculosis-free herd?

PRACTICALLY all the senior radio officials of every European State were present at the conference of radio engineers held at Geneva on July 6-8. The question of broadcasting has become one of great urgency as there are more than 110 stations in Europe which are sending out ether waves, the lengths of which in several cases are nearly identical. As a separation of frequencies of 20 kilocycles is desirable to prevent interference, and as the limits of broadcasting frequencies are narrow, it was found quite impossible to give to each station, existing and projected, an exclusive frequency. It was necessary, therefore, to give to some stations small in power the same frequency as other stations remote from them. Engineers, however, are not certain that when all the stations are in operation simultaneously there may not be serious interference in certain places. They therefore hope to make experiments about midnight in the early days of September, when it is arranged that all the European stations will broadcast simultaneously. Owing to the practical difficulties in the way of standardising frequencies within narrow limits, it is anticipated that in several places listeners will have difficulty in tuning out interfering stations. Plans have been made to meet again at Geneva to discuss the experimental results. It is proposed to transmit from a large European station signals of given frequencies so as to enable all the broadcasting stations to check their waves. It is interesting to notice that Great Britain has the largest number, 20, of existing stations, Germany comes next with 16 and then France, Spain and Sweden with 12 each.

AT the International Conference of Women in Science, Industry and Commerce, held at the British Empire Exhibition Wembley, on July 15-17, Miss H. M. Davis read a timely paper on electricity in mines. Miss Davis pointed out that the main costs of mining coal are due to manual labour and mechanical power. The large and increasing use of electricity has enabled many economies to be made. The modern electrical coal cutter is highly efficient; although it stands on only a few square feet it is capable of developing 40 h.p. The conveyors are operated by specially constructed motors, and the tubs into which the coal has been loaded from the conveyors are taken to the bottom of the shaft by electric haulage. The winding equipment at the pit-mouth is often now operated electrically. In addition, electricity is used for pumping, ventilating, compressing air, coal washing and many similar purposes. Unfortunately, the colliery load factor, that is, the ratio of the actual energy consumed per week to the total energy that could have been consumed if the pit were always working, rarely exceeds 50 per cent. Increasing the number of pits supplied by a central station has little effect on the load factor, and hence supplying a large number of pits from a large common central station does not necessarily lead to increased economies. Miss Davis concluded that unless power can be supplied to the collieries at a price of about 0.7*d.* per unit, most colliery companies would be well advised to generate their own power. Provided, however, that the winding shifts could be arranged so that the load factor was reasonably constant, a great reduction in the power costs could be effected. If all the workers co-operated it would be possible to achieve this result in practice.

THE aim of the recently opened Research Institute in Animal Pathology, Royal Veterinary College, London, is to increase knowledge regarding the diseases of the domesticated animals, and the subjects selected for investigation from time to time will be those which appear to be of the greatest importance, either on account of the loss which they cause to agriculture, or because of their connexion with disease in the human subject. In the immediate future, investigations which have for some time been in progress will be continued with regard to Johne's disease, abortion in cows and mares, and quarter-evil. It is intended also to bring under investigation diseases caused by parasitic worms in lambs and calves, and calf diphtheria. Parasitic diseases are annually the cause of great loss throughout Great Britain, and there is evidence that few, if any, of the methods at present employed are efficacious for destroying the worms within the body. The cause of calf diphtheria has long been known, but in the present state of knowledge it is scarcely amenable to treatment. An effort will be made to discover a method of vaccination by which the disease may be prevented in young animals exposed to risk of infection. Although the Institute is well equipped from a scientific point of view, it is realised that laboratory investigations in order to be fruitful generally require the collaboration of stock owners and practising veterinary surgeons, and the Director wishes it to be widely known that the Institute is a place to which the members of both these classes may appeal for advice and assistance in connexion with any serious disease which appears to them to require investigation.

IT may be remembered that the protection of scientific discoveries which are not inventions and as such are incapable of being patented was the subject of a report to the League of Nations in 1923 by Senator F. Ruffini (NATURE, April 26, 1924, and May 3, 1924). The League has now published replies which it has received from the Government of Finland, the Irish Free State, and the Government of Hungary (League of Nations, C. 217, M. 74, 1925, xii). The Government of Finland, while acknowledging the injustice of the laws which deny protection to the intellectual work of the man of science considers that the suggestions propounded by Senator Ruffini could usefully be applied in the case only of a few branches of science such as physics and chemistry, and to some extent physiology and medicine. It admits, however, that this restriction of the field of application of proposed protection is not a sufficient motive for rejecting the scheme. It points out that scientific

investigators do not work for economic profit as a direct result of discoveries, and that to some extent they are compensated by public recognition and by the conviction of having done work for the good of humanity After enumerating difficulties in the application of the League's proposals, the reply adds that the matter is to be brought up at a Congress of Jurists to be held at Helsingfors in August next The Irish Free State concurs in the opinion that the originator of a valuable scientific discovery is entitled to receive material recognition for his work, but it is not satisfied that the proposals outlined in the draft convention which accompanied Senator Ruffini s report are capable of satisfactory adoption

THE Government of Hungary, referring to Senator Ruffini's report, states that while in the opinion of all nations inventions can only be effectively protected when their practical work has been demonstrated in concrete form, the proposals made aim at protecting inventions at a stage when they have not yet had an opportunity of proving their value It points out however that an obligation of affording to intellectual work the legal protection asked for by the League has already been conceded by certain Provisional Rules of Jurisdiction laid down in 1861, although the law regarding authors' and inventors' rights does not give complete application to this principle The Hungarian Government hails Senator Ruffini's proposals with the greatest satisfaction, but is not convinced that the methods suggested would in practice be the best It considers that an agreement ought first to be arrived at between States, in virtue of which each country would undertake to amend and develop its own laws with the view of ensuring the most effective protection of intellectual work, and that when these changes have been made, the various countries should conclude an international convention under which they would mutually support each other in affording protection to intellectual production

THE advantages of co-operation and fear of German and other foreign competition were the keynotes of the speeches made at the ninth annual meeting of the Association of British Chemical Manufacturers, held on July 9 in London Mr Milne Watson the chairman, referred to the growing spirit of co-operation between the dyestuffs industry and other branches of chemical industry This industry is in a difficult position, but the same may be said of the dyestuffs industries in the United States Italy, France, and Japan, whilst even those of Germany and Switzerland have their troubles British dyestuff manufacturers will have to double their efforts before the home industry can be said to be safely established on an adequate scale The fine-chemical industry has had a fairly quiet time, but a strenuous year awaits it, for in 1926 the Safeguarding of Industries Act expires, and the Government will want to know what progress has been achieved during its duration Our manufacturers are already taking stock of the position Dr E F Armstrong complained of the difficulty in finding suitable chemists possessing the necessary broad outlook, and he hoped the Association would induce the universities to alter their course of training Several speakers emphasised the danger of increased competition from Germany, which, it was stated, is now more serious than it was in 1914 German manufacturers have eliminated competition at home, all the smaller firms have been absorbed in the large ones, plant that was not absolutely up-to-date or capable of reconstruction has been scrapped reports on labour are uniformly good, the burden of overhead charges has been removed, and the only apparent trouble is lack of liquid capital

MR E J WAYLAND director of the Geological Survey of Uganda, has sent us a further letter upon the subject of the paragraph on "Petroleum in Uganda," to which he took exception in a letter published in NATURE of June 27, with the contributor s reply to it We are not publishing the letter, but it may be remarked that the correspondence has once again directed attention to the petroleum resources of Africa By the modern school of geological thought it is now generally conceded that the most trustworthy basis of assessment of future resources is that of geotectonic and stratigraphical achievement, and that apart from manifold indices of bitumen (using the word in its widest sense) favourable prospects are alone deducible from the observed occurrence of suitable mother-rocks, reservoir rocks and externally impressed structures while the problem of recoverable commercial supply rests ultimately with the drill Now, excluding the Atlas region of the north, tectonically European (Alpine) in its affinities, and the Red Sea region of the north-east, Africa, by virtue of its great antiquity, the nature of its rocks and broad similarity to vast plateaux such as those of Brazil or the Indian peninsula, seems to lack those geological desiderata usually regarded as essential to the genesis, concentration and permanence of large oil-pools, comparable, for example, with those of Burmah, Persia or Rumania thus arguing on first principles by analogy, and also from the results of several past unsuccessful ventures in the search for petroleum along the east and west coasts, in the Transvaal, and in the interior (*e g* south of lat 25° N), many have been confirmed in their initial scepticism of the oil potentialities of this great continent, as in similar cases of northern Canada, Brazil, southern India, Arabia, Siberia, Australia, etc It is none the less a welcome sign that certain African geological surveys include research for petroleum in their programme, and while some people may be sceptical of ultimate commercial results, the scientific importance of such work is unquestioned

ON May 17–24, representatives of the geophysical institutions belonging to the numerous republics of the Soviet Union gathered in Moscow for the first scientific Congress of Geophysics Beside scientific work this assembly had to deliberate on a number of questions of organisation in quest of the right way of resolving a most complicated problem, that of the co-ordination of the geophysical service in a country

so extensive as the Union of the Socialist Soviet Republics The scientific work of the Congress was discussed by the following five sections (1) meteorology, aerology and general topics, (2) actinometry, electro-meteorology, atmospheric optics and acoustics, (3) climatology, (4) dynamic and synoptic meteorology (5) terrestrial magnetism, seismology and graviometry Beside these five sections a special commission for the study of drought and its peculiarities was organised 335 reports were presented for the consideration of the assembly, 75 relating to questions of organisation and 260 scientific reports There were no less than 511 delegates at the Congress

THE third International Congress of Entomology opened its meetings at Zurich on Monday July 20, after a reception of the delegates on the evening of Sunday July 19 The first of these Congresses was held at Brussels and the second at Oxford In August 1914 the third was to have met at Vienna, but circumstances made this impossible Science, however, is international, and Time the Healer' suggested the resumption of these meetings and Zurich was chosen as neutral ground About 200 members are in attendance, 60 of them from Britain Nearly all the European countries are represented—though there are significant exceptions—as also India, Canada, South Africa, and the West Indies The United States is represented by Dr L O Howard and others, while there are representatives from Egypt and Mexico Switzerland is naturally well represented, and the president is Dr A von Schulthess A very full programme has been arranged under the sections morphology, systematic entomology, biology and development, bionomics, and nomenclature The social side has not been forgotten In addition to evening meetings for social intercourse, an excursion has been arranged to the Uetliberg, one of the highest points in the neighbourhood of Zurich, from which good views of surrounding peaks may be had, and a sail round Lake Zurich A banquet is being held on the night of July 24 On July 25, after some sectional meetings in the forenoon a general business meeting is being held, at which the time and place of meeting for the next Congress will be arranged

THE Trustees of the late Sir William Dunn have made a donation to the Medical Research Council of 2000*l* per annum for a period of five years to be used for the promotion of research work in medicine at the discretion of the Council The Medical Research Council, in accepting this generous benefaction has intimated that for the present this special Dunn Fund will be applied mainly to the furtherance of the organised studies of filterable viruses which it is supporting, and in particular to the recent developments of this work in relation to cancer by Mr J E Barnard, Dr W E Gye, and their colleagues It will be recalled that the Dunn Trustees have already made many important benefactions for the advancement of medicine They have endowed a chair of pathology at Guy's Hospital, London, and erected a School of Biochemistry and endowed a chair in biochemistry, now held by Sir Frederick Hopkins, at Cambridge, they have given a new building for the School of Pathology at Oxford now being erected, and have provided equipment for the School of Pharmacology there They have also built and equipped laboratories for the University Medical Clinics at St Bartholomew's Hospital, St Thomas's Hospital and the London Hospital

AT the annual general meeting of the Faraday Society, held on July 6 the following officers were elected *President* Prof F G Donnan, *Past-Presidents* Sir Robert Hadfield, Prof Alfred W Porter, Sir Robert Robertson, *Vice-Presidents*, W R Bousfield, Prof C H Desch, Dr W H Hatfield, Prof W C Lewis, Mr C C Paterson, Prof A O Rankine, Dr E K Rideal *Treasurer* Mr R L Mond During the past year general discussions on the following subjects were held (1) "Fluxes and Slags in Metal Melting and Working" (2) "Physical and Physico-Chemical Problems relating to Textile Fibres" (3) "The Physical Chemistry of Igneous Rock Formation," (4) "Base Exchange in Soils" It is the policy of the Society to co operate wherever possible with other scientific societies, and three of these discussions were held jointly The policy of co-operation is also extended to the American Electrochemical Society, in that by a mutual arrangement the Transactions of each society are supplied to the members of the other society at a special rate In addition to the general discussions, four ordinary meetings were held One section of the Report refers to the convention that should be adopted as regards the sign of the potential on an electrode The Council is not prepared to make an official pronouncement on the subject, and the opinion is expressed that such matters should be settled by international agreement During the year thirty-three new members were admitted to the Society There was an adverse balance of 293*l* on the year's work, due to the great amount of material published While loth to diminish the Society's activities, it has been decided to limit the general discussions for the time being to two a year, and it is expected as a result to balance income and expenditure during the present year

ACCORDING to the annual report of the Trustees of the Beit Memorial Fellowships for Medical Research, there were last year 93 fellows on the Fellowship register and 23 Fellowships were occupied Further elections have taken place as follows Senior Fellowship (600*l* per annum for 3 years), Mr H D Kay, 4th Year Fellowships (400*l*), Mr E B Verney and Mr J L Rosedale Seven Junior Fellowships (350*l* per annum for 3 years) were also awarded, and the nature of the proposed research and place where the fellowship is tenable appears after the name of the new fellow Dr G H Eagles, to study the specific agglutinogenic properties of streptococcus scarlatinæ and the possible further specific grouping of hæmolytic streptococci occurring in other pathological processes (The Lister Institute of Preventive Medicine, London) Miss D M Needham, (1) a study of the oxidation-reduction potential of various organisms and tissues (2) a continuation of the study of the pancreatic factor inhibitory to lactic acid formation

in muscle (Bio-chemical Laboratory, Cambridge) Dr E N Chamberlain, effects of the anterior lobe of the pituitary gland on the liver and other organs of the body, investigation of the relation of pituitary and other ductless glands to cholesterol metabolism and their inter-relationships (Johnston Laboratory of Bio-Chemistry, University of Liverpool) Mr E N Allott, the growth of bacteria on artificial media to attempt to grow bacteria on purely artificial media, consisting of simple compounds, such as simple sugars, amino acids, and salts (Bio-Chemical Laboratory, Cambridge) Mr F C Kelly, to continue research on iodine metabolism especially the iodine requirements of animals and the influence on nutrition of diets deficient in iodine (Bio-chemical Laboratory, Cambridge) Mr D E Denny-Brown, to investigate spastic paralyses, decerebrate rigidity, and allied conditions, more particularly with regard to the influence of the sympathetic nervous system upon them (Physiological Laboratory, Oxford) Mr B S Platt, the relationship existing between the formation of peroxides by bacteria and certain of the phenomena of immunity (Bacteriological Laboratory of the Department of Pathology, The School of Medicine, Leeds) Thus three of the new fellows of the seven will be at the Biochemical Laboratory Cambridge

WE regret to announce the death, on July 14, at the age of sixty-seven years, of Dr F E Beddard, F R S, formerly prosector of the Zoological Society, London and naturalist to the *Challenger* expedition, who was distinguished for his work on the Oligochæta and on the structure and classification of birds

THE Civil Service Commissioners have appointed Mr A C Stephen, at present a junior naturalist on the scientific staff of the Fishery Board of Scotland, to be assistant in the Natural History Department of the Royal Scottish Museum, Edinburgh, in succession to Dr E L Gill recently appointed Director of the South African Museum, Cape Town

APPLICATIONS are invited for the following appointments, on or before the dates mentioned A lecturer in chemistry and physics at the Exeter Diocesan Training College for Schoolmasters—The Principal, St Luke's College Exeter (July 31) A botanist (temporary post) at the Royal Botanic Gardens, Kew —The Secretary, Ministry of Agriculture and Fisheries 10 Whitehall Place S W 1 (August 5) A resident tutor for mathematics and physics at the Borough Road Training College—The Secretary, British and Foreign School Society, 114 Temple Chambers, Temple Avenue E C 4 (August 8) Two junior engineers at the Forest Products Research Laboratories of the Department of Scientific and Industrial Research, South Farnborough—The Secretary, The Department of Scientific and Industrial Research 16 Old Queen Street S W 1 (August 8) An evening lecturer in bacteriology at the Battersea Polytechnic—The Principal A full-time lecturer for day and evening classes in engineering at the Erith Technical Institute —The Principal A graduate master for physics and chemistry at the Andover Grammar School—The Director of Education, The Castle, Winchester A lecturer in science including biology, nature study or gardening at the Diocesan Training College, Ditchling Road, Brighton—The Principal

Our Astronomical Column

RETURN OF WOLF'S PERIODIC COMET —The opening, on July 13, of the meeting at Cambridge of the International Astronomical Union was marked by the detection by Dr Stobbe at Bergedorf Observatory of this interesting periodic comet which has been observed at nearly every return since its discovery in 1884 Prof Kamiensky, Director of the Warsaw Observatory, was present at Cambridge and received many congratulations on the brilliant success of his prediction, the error of his predicted place was only 4′, although the perturbations by Jupiter at the last return were so enormous, that the perihelion distance has been increased by an entire astronomical unit the orbit having in fact, reverted to its form of fifty years ago when Jupiter acted to reduce the perihelion distance The perturbations during the whole fifty years have been investigated by Prof Kamiensky and the successful prediction gives evidence of his skilful and accurate work

The comet was of magnitude 15 at rediscovery on July 13 and will remain too faint for ordinary telescopes throughout the apparition It will however, be brighter by a magnitude or two when it reaches perihelion on November 8

Brooks' Comet, the perturbations of which have been investigated by Prof Dubiago, also suffered large disturbances by Jupiter at aphelion, and is also due at perihelion on November 8 Search for it and for Faye's Comet (due at perihelion about August 6) is now being made Borrelly's and Kopff's Comets are also due in a few months, so that comet searchers are being kept busy Tempel's Second Comet has brightened considerably and is now an easy telescopic object It has a short tail

NOVA PICTORIS —*Astr Nach* 5379 contains an interesting note on this Nova by J Hartmann of the La Plata Observatory The Nova had been under observation there from May 27 to June 5 during which time its brightness increased slowly, as the following table shows

	Mag		Mag		Mag		Mag
May 27	2 8	May 29	2 5	June 1	2 1	June 4	1 9
,, 28	2 6	,, 30	2 4	,, 2	2 1	,, 5	1 8

(Dr Spencer Jones states that it afterwards attained the first magnitude)

The increase of light has been more gradual and has lasted longer than in most Novæ, and the changes in the spectrum were also more gradual

Hartmann obtained photographs with a small single prism spectrograph These showed a continuous spectrum of the first type, with numerous strong absorption lines, of which the *H K* calcium lines were the strongest followed by those of hydrogen, helium, magnesium, etc The hydrogen lines H_β, H_γ, and several other lines, showed a faint emission line on the less refrangible side of the absorption one He, like Dr Spencer Jones holds out hopes that the somewhat unusual behaviour of this star may add materially to our knowledge of the nature of the processes that give rise to these outbursts

It is interesting to note that Mr Watson, who discovered this Nova appears to have been the first to detect the outburst of Nova Aquilæ in 1918, so that he, like Mr Anderson, has the record of two brilliant Novæ It is fortunate that this Nova is circumpolar at the southern observatories, so that it will be possible to follow its decline without any break through the time of its conjunction with the sun

Research Items

CU-CHULAINN AND TOTEMISM.—In *Man* for June, Dr Géza Roheim, whose ingenious and suggestive psychoanalytic study of totemism in Australia has just been published in Great Britain, applies the same analytical method to the Cu-chulainn cycle of Irish legend with reference to its bearing upon the problem of totemic origins. Not only is the dog taboo of Cu-chulainn probably totemic, but also he becomes a dog by killing a dog. In other words, the legend contains more or less veiled references to the father-and-son conflict for the women of the Cyclopean family, from which, Freud holds, totemism and exogamy arose of the animal symbol arising out of a feeling of guilt for the act of parricide, and of incest committed by the hero. Cu-chulainn slays the dog of Cu-lain the smith, and serves in its stead, as other Aryan heroes served a term of apprenticeship with a smith, from whom they usually obtained their terrific weapon. But the smith and his dog are to be regarded as identical and the former represents the father. The slaying is therefore parricide. Cu-chulainn fights with and kills his own son, but Lugaid, who deals him his death-blow, is probably also his own son by an incestuous union, although ostensibly the son of Curoi. Curoi, the archaic form of the Oak King, is also to be regarded as the father of Cu-chulainn by whom he is killed. If then the smith is equated with his hound, the combat is between two heroes of the dog clan, and when Cu-chulainn breaks the taboo he is slain by his son Lugaid, a parallel being the case of the Baja King, who eats his totem animal when death at the hand of his son and heir draws near.

MORPHOLOGICAL DIFFERENTIATION OF BACILLUS TYPHOSUS.—L. Nicholls and E. Burgess direct attention in the *Ceylon Journ. of Science*, Sect. D (Medical Sc.), vol. 1, pt. 2, 1925, p. 47, to the discrepancies which occur in text-books between the sizes given in the text and the magnifications stated under the illustrations respecting certain micro-organisms. They believe that were more attention given to the accurate comparison of the size and morphology of different organisms, much help would be derived for purposes of differentiation and identification. As an example, they have compared the morphology of *B. typhosus* with that of 40 other bacilli isolated from water. The organisms were grown on three standard media: (1) ordinary nutrient agar, (2) salt (3 per cent.) nutrient agar, and (3) salt-free peptone agar. Stained preparations were made and photographed under similar conditions. It was found that the *B. typhosus* could be distinguished almost at a glance from any one of these 40 water organisms by its characters when grown on these media. As regards the 40 water organisms, these corresponded morphologically to about 30 species, which agreed well with the results obtained by an extended series of culture and fermentation tests.

THE BRITISH FRESHWATER PEARL MUSSEL.—Considering that it is still an article of economic value, although less so than formerly, it is remarkable how imperfect is our knowledge of the life-history of the British freshwater pearl mussel. What is known has been admirably summarised by Mr. J. Wilfrid Jackson, of the Manchester Museum, in the introduction to his address to the Conchological Society on "The distribution of *Margaritana margaritifera* in the British Isles" (*Journ. of Conch.*, 17, No. 7), a paper all the more valuable on account of the numerous references to original sources of information. The mollusc has a remarkably wide circumpolar distribution and exhibits persistent specific characters. Nevertheless, although the glochidial stage is known, the transitional stages between that and the adult are unknown and unrepresented in collections save for four young shells, in Mr. Jackson's own possession, coming from the River Conway. What the habitat of the young shells may be is at present a mystery (cf. Prof. A. E. Boycott in NATURE, August 23, 1924, p. 276). One would infer that they resort to deep water, since in shallow they would have been found long ere this. At the same time it should be observed, although not emphasised by Mr. Jackson, that these young shells might easily be mistaken for the juveniles of a species of Unio, because they are not black like the adult, nor do they exhibit the characteristic concavity of the ventral margin, whilst they are furnished with a complete set of hinge teeth similar to those of Unio. The assertion has been made by Dr. Haas that Margaritana (or, as it should be called, Margaritifera) is intolerant of hard water, and certainly it obviously shows a preference for soft waters, which makes it difficult to explain the markedly thick shells of the species. Prof. Boycott's appendix to Mr. Jackson's address, however, shows that this question evidently requires further investigation. A very full account of the distribution of the single British species, accompanied by a most instructive map, forms the conclusion rather than the bulk of the author's very valuable paper, to which we are glad to note there is to be a second part dealing with the past history of the mollusc.

RED CLOVER.—Critical studies on the pollination, fertilisation, and breeding of red clover have led to conclusions of practical importance to agriculturists (R. D. Williams, Welsh Plant Breeding Station Publications, Series H, No. 4). Under ordinary conditions red clover is not self-fertilised, but a small number of plants are self-fertile if artificially self-pollinated, individual plants varying in the degree to which they are capable of this. The property of self-fertility is probably inheritable, and is greatly increased if pollination is effected before the flowers open, but so little seed is produced that it is doubtful if self-pollination can be of much practical use in the breeding of red clover. Humble bees are the chief agents in effecting cross-pollination at Aberystwyth and in Montgomeryshire, honey bees playing but a very small part. Six species of humble bees were observed on red clover, *B. agrorum* and *B. hortorum* being by far the most numerous and important, probably being responsible for 70 to 80 per cent. of the total yield of clover seed in these districts. The seed yields are to some extent reduced by robber bees, *B. terrestris* and *B. lucorum*, and it is suggested that their depredations might be reduced by growing small areas of *Vicia villosa* near the clover, as this is a most attractive bait for these insects. As the bees are most abundant in early August, the yield of seed is much increased if the flowering of the clover is postponed until that time by means of judicious cutting of early strains or by growing late flowering strains. Larger yields might be obtained if more bees were available, and investigations are in hand with the view of increasing their numbers by judicious encouragement. Various methods of artificially breeding red clover have been tried, hand cross-pollination and controlled cross-pollination by humble bees being the two most promising methods of attack. Hand pollination is useless when many seeds are required or several plants are being intercrossed, but humble bees confined in various types of cages prove to be

very efficient agents, especially *B agrorum*, *B hortorum*, and *B helferanus*

PRODUCTION OF ALCOHOL FOR MOTOR FUEL IN THE TROPICS —The question of making an efficient motor fuel in the tropics, where imported spirit is expensive, is at present attracting considerable attention Various materials have been suggested, and in some cases tried, as a source of power alcohol, such as starch-containing roots, and cellulosic residues from the sugar and other industries, but one of the most valuable appears to be the sap which may be collected from the flowering shoots of the Nipa palm of the Far East Considerable work has been done in the Philippine Islands in ascertaining the suitability of this palm for the production of alcohol and quite recently an experimental plant has been erected in the State of North Borneo The plant is being run under the direction of the local Department of Agriculture and an account of the results of the first year s working, based on a memorandum supplied by the British North Borneo Company, is given in the current issue of the *Bulletin of the Imperial Institute* published by Mr John Murray There are about 300,000 acres of Nipa palm in North Borneo, occurring in nearly solid stands of 5000 acres or more The sap flows for only six months in the year, but it is estimated that during this period 900 000,000 gallons of sap capable of producing nearly 60,000 000 gallons of alcohol could be obtained The results of the first year's working of the experimental plant came up to expectations in every way The still was only capable of producing 100 gallons of alcohol per working day of 12 hours, and the costs of running such a small plant were naturally somewhat high, but it is shown that a permanent plant producing not less than 1000 gallons per day should prove a commercial success

FORMATION OF MALACHITE —The May issue of the Journal of the Chemical Society contains a paper on the mechanism of the formation of malachite ($2CuO, CO_2$) from basic copper carbonate, by J R I Hepburn At ordinary temperatures the transformation appears to be caused through the intermediate agency of an aqueous solution of carbon dioxide or sodium hydrogen carbonate In the former case normal malachite crystals are formed , in the latter, sphærocrystals are produced, probably through crystal growth in a colloid medium (unchanged basic copper carbonate) Gelatin retards the change The formation of malachite at 100° (by thermal decomposition of the blue solutions prepared by dissolving the basic carbonate in saturated sodium hydrogen carbonate) occurs as a surface film of interpenetrating sphærocrystals, which is disrupted into individual crystals on further boiling The direct cause of the change is attributed to loss of carbon dioxide from the sodium hydrogen carbonate at 100° with formation of the stable double salt Na_2CO_3, $NaHCO_3$, $2H_2O$ and malachite Gelatin likewise retards this change

THE SODIUM SPECTRUM —The July issue of the *Philosophical Magazine* contains a short communication from Prof F H Newman, describing a successful attempt to obtain the spectral lines of sodium vapour due to changes of orbit involving less energy than that necessary for ionisation The sodium vapour was contained in a triode tube of quartz maintained at 350° C in an electric furnace The electrons were supplied by a dull tungsten filament, and between the filament and the grid an increasing electromotive force was applied, the spectrum produced being photographed by means of a quartz spectrograph After applying a correction of 0 4 volt to the observed potential to get the potential corresponding to the energy with which the electrons pass through the grid, the author found that, in accordance with theory, at 2 2 volts the doublet 5896-90 only appeared, at 4 0 volts the doublet 3303-2, at 4 4 volts the doublet 6161-54, and at 4 6 volts the doublet 5688-3 appeared in addition

MASS OF COMPOUNDS OF SILVER WHEN STRONGLY ILLUMINATED —Messrs P P Koch and B Kreis describe, in the *Zeitschrift fur Physik* of May 16, measurements made on particles of silver bromide and silver chloride the mass of which was about 10^{-11} gr The particles were made to float in air in the electrostatic field of a condenser, in which they were observed by means of a microscope The particles were strongly illuminated by means of an arc lamp and a powerful condenser the mass being determined before and after illumination by means of measurements of the condenser voltage and of the charge of the suspended particle The intensity of illumination employed was so high as 67×10^6 metre candles , and it was found that in a short time the loss of mass was so great as 25 per cent This loss appears to be due to separation of the halogens Silver iodide under the same conditions showed only very small alterations in mass The apparatus may be regarded as a very sensitive microbalance in which particles of the same order of size as those in a photographic plate can be weighed, and the theory of photographic action can be directly tested

LOUD-SPEAKERS —The Marconiphone Co , Ltd , of Marconi House, Strand, now manufacture a loud-speaker which enables anyone to address an audience of many thousands and at the same time to be heard by equally large gatherings up to a distance of about 150 miles with the help of the Post Office land wires The total equipment can be purchased outright or can be hired for 5*l* per week A powerful voice is no longer a necessity for a public speaker, and this ought to improve the quality of " orations " as the number of possible orators is largely increased The distinguishing feature of the Marconi instrument is that it responds with equal sensitivity to all notes in the musical scale whether the sound originates 100 feet or 10 inches from its position Recently a nightingale's song was broadcasted from the London broadcasting station, 2LO by this device The bird was singing about 100 feet away from the instrument yet the song could be heard almost perfectly by broadcasting listeners The apparatus has many points of difference from domestic loud-speakers The construction is on the moving coil principle, and the diaphragm is of rubber and not of metal As it has no natural or resonant frequency of its own, it is practically free from nasal defects, and there is no metallic timbre The normal working range of one of these loud-speakers under reasonably silent conditions is approximately three-quarters of a mile

SORPTION OF GASES BY GRAPHITE —The sorption of oxygen by " activated " graphite forms the subject of a paper by D H Bangham and J Stafford in the Journal of the Chemical Society for May If s is the quantity of oxygen sorbed at time t after its introduction to the graphite, then the relation $s = kt^b$ holds, k and b being constants, both for ordinary graphite and for graphite containing hydrogen sorbed in a discharge tube The results seem to indicate that the sorption of oxygen by ordinary graphite is due more or less directly to the hydrogen which it contained on manufacture No water seems to be produced by the sorption of oxygen by graphite containing hydrogen , the sorbed gases may be pumped off as such

The Nature of the Cell Membrane

IS there a semi-permeable membrane to the cell? This question is examined by Prof L Lapicque in a review of very general interest which accompanies seven more technical contributions in animal, vegetable or general physiology, in the first number of a new French journal, *Annales de Physiologie et de Physicochimie biologique* (Paris Gaston Doin annual subscription 45 francs outside France) The following, save for reference to some recent cognate American work is based entirely upon Prof Lapicque's stimulating and timely article

Lapicque admits at the outset that he finds the conception of a semi-permeable membrane around the cell a hindrance rather than a help in the interpretation of the behaviour of the cell, he therefore critically examines the case for such a membrane as presented by Bayliss in his great text-book The idea of a membrane arises naturally when it is realised that protoplasm, though behaving in many ways as a protein sol can frequently exist in contact with water without dispersing in colloidal solution throughout the aqueous medium Clearly there is then a protoplasm water interface, and probably every one would agree that protoplasm at this interface has different properties from those characteristic of the main mass of protoplasm Do these properties, however necessarily include a different penetrability to solutes which justifies its distinction as a semi-permeable membrane enveloping a mass of readily permeable plasm? Even the advocates of the membrane will probably agree it is a phenomenon of the surface and that particles of protoplasm may lose and regain these surface characteristics as they leave or enter the surface layer Certainly the ease with which the protoplasmic surface changes in amœboid movement, leaving no collapsed membrane as the surface retracts, suggests that any change undergone as protoplasm enters the surface layer is reversible in nature Whenever a permanent structural membrane can be identified at the surface of the cell, it is something distinct from the surface of the protoplasm, as is the cellulose wall of the plant, and is not the seat of any semi-permeable properties shown by the protoplast, so that in plasmolysis the plant protoplast withdraws itself inward from the permeable cellulose wall around it The semi-permeable properties of the hypothetical membrane are usually interpreted as due to a sieve-like action From this view-point no non-living semi-permeable membrane has been shown experimentally to be impermeable to molecules of less than about twenty atoms The living membrane, however, is assumed to control the passage of inorganic ions One may invoke the view that such ions move accompanied by a cluster of water molecules, but the fact remains that the non-living membranes fail to arrest their passage

The distribution of ions upon either side of a semi-permeable membrane is now frequently attributed to the Donnan equilibrium when a non-diffusible colloid on one side of the membrane forms ionisable salts with electrolytes Consideration of the case of gelatin however, shows that so long as the colloid is non-diffusible, no special membrane is required for the existence of a Donnan equilibrium

Thus whilst for mathematical and physico-chemical argument the ideal semi-permeable membrane is a necessary concept, in experimental fact it has never been demonstrated, and there are considerable difficulties in assuming its existence For example botanists realise that inorganic salts must diffuse freely into the plant, and they interpret experimental observations of recovery from plasmolysis induced by external concentrations of inorganic salts as evidence that such diffusion is occurring On the other hand, present data as to the entry of salts, as summarised recently by Stiles in his monograph upon permeability, do not support the assumption that salts will diffuse through the plant protoplast until the ratio of salt concentrations in external solution and in the vacuole will be unity

Bayliss argued that the resistance of the cell to the electric current in view of its content in free electrolytes, could only be explained on the assumption of semi-permeability Lapicque points out that if this was the true explanation, the cell would behave as a condenser in an electric field and that once the cell was fully polarised no more current would pass Actually the high resistance may be explained equally well if protoplasm is regarded as a permeable but highly viscous medium

Bayliss also stipulated the existence of a membrane on the following grounds (1) In the presence of various electrolytes in solution the cell undergoes a permanent change in volume, (2) the electrolytes within and without the cell differ in kind and in concentration Lapicque deals with these arguments at some length The change of volume of the vacuolated cell is admitted but so also is the fact of recovery from plasmolysis, which shows that we are dealing with slow penetration of salts, not semi-permeability

In any case this phenomenon is exhibited by the whole thickness of the cytoplasm, there is no evidence of the special role of a surface membrane In the normal non-vacuolated animal cell, contraction of volume also takes place in the presence of salt solution, but this phenomenon cannot be attributed to the osmotic withdrawal of water from a non-existent vacuole and is paralleled by the behaviour of gelatin and many other colloids, without superficial semi-permeable membranes when placed in similar salt solutions

As to the difference in kind and in degree of the concentration of salts within and without a membrane, all through the life of a human being the red blood corpuscles circulate in a medium rich in sodium and poor in potassium, and yet themselves remain rich in potassium and poor in sodium To maintain this relative difference in concentration a membrane would surely need to be impermeable, but as Moore and Roaf said in 1908, if such a membrane thus imprisons the salts and prevents adjustments of concentration, how did the salts enter the prison?

Lapicque approves the general conclusion of Moore and Roaf that the ratio of concentrations of these ions within and without the living corpuscle depends upon a mobile equilibrium between cell constituents and surrounding liquid and is not controlled by diffusion restricted by a semi-permeable membrane Hamburger s experiments have shown these corpuscles to be very permeable to salts so that any change in the medium produces an exchange of inorganic solutes between the corpuscles and the medium Hamburger continues to regard the corpuscles as surrounded by a semi-permeable membrane, so that the loss of hæmoglobin in solutions hypotonic beyond a certain degree is explained as due to the bursting of the membrane Lapicque points out that these laked corpuscles still change in volume with change in salt concentration, just like the original red corpuscles so that if the membrane is destroyed, some of the properties still remain which it was postulated to explain

Hoagland and other American workers have recently provided in plant physiology equally puzzling data as to the distribution of inorganic ions within and

without the vacuolated cell Using Valonia and Nitella, marine and fresh-water algæ forms respectively, which have large enough cells to enable the sap to be collected from individual cells, they supply grounds for thinking that certain inorganic ions, for example potassium, are mainly, if not entirely, in solution in the sap of the vacuole, and yet retain a concentration much higher than that in the outside solution The case of chlorides is particularly remarkable Nitella will absorb practically every trace of chloride from the external solution and will remain alive in distilled water for sixteen days without giving up any detectable trace of chlorine to the water, although containing very appreciable quantities in the vacuole Hoagland concludes that Nitella under normal conditions possesses uni-directional permeability with reference to chlorine and potassium (*Journ Gen Physiology* 5 pp 629-646 1923)

Lapicque concludes that the simple doctrine of the semi-permeable membrane, as employed to explain the salt content and swelling properties of the living cell will soon appear as inadequate as the astrological conception of the firmament which makes it a crystal vault studded with stars He adumbrates as factors, in a more adequate explanation, the distribution of salts according to the Donnan equilibrium between a non-diffusible amphoteric colloid and an aqueous membrane, with the great sensitiveness of such an equilibrium to hydrogen ion concentration, and also the hydrophilic behaviour of lipoids, which varies with the proportion of cholesterin to fatty acids or to lecithin In view also of the modification reported in mitochondria with changes in external medium, he suggests that account may have to be taken of the physiological role of these structures, at present almost exclusively studied by the cytologist Finally he points out that the protoplasm is the seat of continuous transformation of energy and that the phenomena under consideration will not admit of solution in terms of a passive semi-permeable membrane To this last point the supporters of the membrane may reply that they have always assumed that a living cell owes its semi-permeable properties to a living membrane

Maori Ethnography [1]

FOR more than half a century the New Zealand Institute has published in its Transactions a vast amount of valuable information upon all aspects of the history of a group of the most interesting islands in the world In the earlier years of the Dominion few of the colonists were intimately acquainted with the native language, and fewer still could penetrate the veil that hides the thoughts and ideas of the Maori mind Many of these ethnological contributions therefore, are of doubtful reliability They are nevertheless, often quoted by anthropological writers in other countries who are unable to discriminate between the wheat and the chaff After the New Zealand University, with its highly cultivated staffs in its various colleges, began to liberate on the colony graduates trained to careful observation and exposition it was soon recognised that the scientific study of the native race was an undertaking of the utmost urgency, for the day was already far spent for the garnering of what remained of their rapidly vanishing traditions and beliefs

New journals were therefore necessary for recording exclusively these anthropological data The chief of these are the Journal of the Polynesian Society the Bulletins of the Dominion Museum, and the Records of the Canterbury and Dunedin Museums It is the tenth volume of the Dominion Museum Bulletins, by Mr Elsdon Best, that now comes under notice The author emphasises the qualifications with which any investigator of primitive peoples should be endowed "No traveller," he says, "or he of short sojourns may delve into the inner strata of the mentality of barbaric man " [The Maori] 'ever closely shields his true religion" [and] " his inner mentality from the inquisitive gaze and analytical probing of inquiring outsiders In order to open the pages of the inner life of such folks it is highly necessary to gain his confidence A long residence in their midst, a good knowledge of their language A quiet and non-critical bearing, a heartfelt sympathy with the feelings and prejudices of the people"

Just such are the qualifications possessed by the author, and consequently he has attained to the position of one of the most trustworthy interpreters of Maori psychology, and one of the highest authorities on their customs and beliefs

The section of the Bulletin we have before us, a closely printed report of 264 pages incorporates a vast amount of new and valuable, but not easily compressible matter It is impossible to do more than summarise its parts (as Mr Best superscribes his chapters) An introductory part deals with the definition, origin and development of religion preliminary to a comparison with Maori religion, the second surveys Maori religion and mythology from the evidence of early writers On this follows a lengthy account of Maori cosmogony, theogeny, and anthropogeny, and further, by a classification of their gods, correcting the mistakes of several ethnologists who have misunderstood the term god as applied to the Maori religion The New Zealand natives, above all the Polynesians of the Pacific, recognise a supreme divinity—Io—possessing divine attributes more nearly akin to the European idea of godhead Part five deals with the offerings, human sacrifices, and images by which their spiritual beings can be influenced This is succeeded by 28 specially interesting pages on the functions of the priests, the sacred places, and divination Many ethnologists will read with surprise the singular fact that the village latrine was a *tuaha* or sacred place *Tuaha* is the word "applied to any place where men's hair is cut, where tapu food is cast away or offered to supernatural beings" and where "rites connected with many matters were conducted" The final part is concerned with an explanation of Maori ritual performances and formulæ—karakia—"a survey of native mentality and its effects as seen in the performance of rites connected with religion and magic," the numerous particulars of which "would require a chapter of cumbrous length" Mr Best tells us, and so in the present Bulletin he can supply only a few illustrations His work "The Maori" just about to be published, will, we hope supply anthropologists with fuller details

One suggestion may perhaps be permitted, that the numerous ritual formulæ quoted in the native language throughout the book and in several pages of addenda, might, if impossible of verbatim translation, be paraphrased to afford the reader, unacquainted with Maori speech, a general idea of their meaning This monograph is of exceptional importance So doubtless will be the second section, which will include a description of Maori magic and many illustrations of native myths and folk-tales

[1] Maori Religion Being an account of the Cosmogony, Anthropogeny Religious Beliefs and Rites Magic, and Folk lore of the Maori Folk of New Zealand Bulletin No 10, Section 1 By Elsdon Best (Dominion Museum Wellington, N Z, 1924)

University and Educational Intelligence

ABERDEEN.—At the summer graduation the honorary degree of LL.D. was conferred on Dr. J. J. R. MacLeod, professor of physiology at the University of Toronto.

The degree of D.Sc. was obtained by R. S. Clark for a thesis entitled "Rays and Skates" and by W. O. Kermack for a thesis entitled "Investigations of the Synthesis and Reactions of Indole Compounds."

BELFAST.—At the meeting of the Senate of the Queen's University held on July 15, a tender was accepted for the erection of buildings for the Department of Agriculture. It is hoped that these buildings will be completed in about 18 months at a cost of 46,000*l*. Of this sum, 34,500*l*. has been given by the Ministry of Agriculture for Northern Ireland, 5000*l*. was contributed by the late Miss Riddell, and 6000*l*. was provided from general University funds.

Applications are invited from British subjects for the Musgrave research studentship in physiology, value 190*l*. Particulars and application forms are obtainable from the secretary of the Queen's University.

BIRMINGHAM.—The following doctorates have been awarded: D.Sc.—W. E. Garner, for papers on gaseous explosions, heats of formation, detonation, crystallisation of organic substances, and other chemical subjects; J. D. Morgan, for papers on the ignition of explosive gases, and flame movements in gaseous explosions; and D. R. Nanji, for papers on chemical and biochemical subjects, mainly on the constitution of starch and the action of enzymes.

CAMBRIDGE.—Sir W. B. Hardy, Gonville and Caius College, and Dr. L. E. Shore, St. John's College, have been reappointed as University lecturers in physiology. Dr. E. K. Rideal, Trinity Hall, has been reappointed as Humphry Owen Jones lecturer in physical chemistry. The Wrenbury scholarship in economics has been awarded to H. C. B. Mynors, Corpus Christi College.

The following have been appointed Henry P. Davison scholars for the year 1925–26: H. H. Thomas, Sidney Sussex College, to Yale University; W. P. N. Edwards, Corpus Christi College, to Princeton University; and G. R. C. Eley, Trinity College, to Harvard University.

LONDON.—The following doctorates have been conferred: D.Sc. (in Chemistry) on Mr. Samuel Glasstone (King's College), for a thesis entitled "Studies of Electrolytic Polarisation"; and D.Sc. (Engineering) on Mr. R. G. Jakeman, for a thesis entitled "Alternating Current Wave-Windings," and other papers.

The University Studentship in Physiology for 1925–1926, of the value of 50*l*. and tenable for one year in a Physiological Laboratory of the University or of a School of the University, has been awarded to Dr. Isaac Cohen, who proposes to carry out research on tethelin under the direction of Prof. E. C. Dodds at the Bland-Sutton Institute of Pathology at the Middlesex Hospital Medical School.

The following are among the awards of the newly instituted University Postgraduate Studentships recently made: Travelling Studentships (value 275*l*.) to Mr. Reginald Percy Austin and Miss Helga Sharpe Pearson. Mr. Austin proposes to study archæology at the British School of Archæology, Athens, and to undertake excavations. Miss Pearson obtained the M.Sc. degree in zoology in 1924 (University College). She proposes to work on early Tertiary mammals in the continental museums among which this material is scattered.

ST. ANDREWS.—Mr. S. R. Kirk, assistant in geology, and Mr. John Williamson, assistant in mathematics, have submitted their resignations on appointment to the new Commonwealth Fund Fellowships, under which British students are enabled to carry on research work for two years in the United States. Six out of the total number of twenty fellowships available in the first year of the institution of the scheme have been awarded to the University of St. Andrews.

Principal John Yule Mackay has resigned the chair of anatomy in University College, Dundee, although he continues to hold office as Principal of the College.

SHEFFIELD.—The University Council has made the following appointments: Mr. I. C. F. Statham, to the chair of mining; Mr. N. M. H. Lightfoot, to be assistant lecturer in mathematics; Mr. Joseph Jenkins, to be assistant lecturer in civil engineering; Miss Esther Lowe, to be assistant in Zoological Department.

THE Busk Studentship in Aeronautics, founded in memory of Edward Teshmaker Busk, who lost his life in 1914 whilst flying an experimental aeroplane, has been awarded for the year 1925–26 to Mr. Stewart Scott Hall, of the Imperial College of Science, London.

BY the will of Sir Rickman Godlee, Bart., who died on April 20, the sum of 10,000*l*. is bequeathed, after his wife's death, upon trust for investment, the income to provide travelling scholarships for students of University College Hospital Medical School, London, who have held a resident appointment in University College Hospital. The ultimate residue of the estate is to be divided equally between University College, London, and University College Hospital, unless the latter is taken over by a public authority, in which event the whole will go to University College.

ROBERT BLAIR fellowships for this year have been awarded by the London County Council to Mr. N. P. Inglis and to Mr. A. B. Miller. The fellowships, which are worth 450*l*. each, are for one year's study abroad. Mr. Inglis, who is a fellow in the University of Liverpool, proposes to continue his studies on the fatigue of metals. Mr. Miller proposes to investigate the metal construction of aircraft with special reference to the materials employed and method of production.

THE Ramsay Memorial Fellowship Trustees have made the following awards for the session 1925–26, the place at which research is to be carried out being indicated in brackets: British Fellowships of 300*l*. to Mr. G. A. Elliott for two years (University College, London), and to Dr. H. R. Ing for one year (University of Manchester); Glasgow Fellowships of 300*l*. to Mr. T. C. Mitchell for two years (University of Cambridge), to Mr. J. D. Fulton for one year (University of Manchester); Canadian Fellowship to Dr. D. McKay Morrison (University of Cambridge); Japanese Fellowship of the value of 370*l*. to Dr. Seisi Takagi (University College, London). The following Fellowships have been renewed: Dr. S. W. Saunders (British Fellowship, University College, London); Mr. Kai J. Pedersen (Danish Fellowship, University of Bristol); M. M. Mathieu (French Fellowship, Davy Faraday Laboratory, Royal Institution, London); Dr. Nicolas Oeconomopoulos (Greek Fellowship, University College, London). Sir Robert Waley-Cohen has been appointed a Trustee of the Ramsay Memorial Fellowship Trust, in succession to the late Sir George Beilby.

Early Science at Oxford

July 28, 1685 Mr President presented ye Society with a Copy of his Algebra lately printed

A letter from Mr Aston dated July 23 was read with it came Hevelius's *Annus Climactericus* presented to this Society by ye Royall Society

Four Mathematicall papers drawn up by Mr Tolet, were presented ye Society three of these papers were concerning gunnery, and ye finding altitudes the fourth mentioned a controversy between Mr Tolet and Mr Hern concerning ye scituation of ye lines of Longitude ye former affirming, that ye line of Longitude lies North and South and ye line of Latitude East and West ye latter affirmes that ye line of Longitude lies East and West, and ye line of Latitude North and South Concerning which controversy Mr Hern having appealed to ye Royal Society at London, and to this at Oxford for a determination this Society on ye account of Mr Hern s appeal and at the request of Mr Ash Secretary of ye Dublin Society gives their opinion which is this They conceive it has been generally received among mathematicians, that ye lines of Longitude ly North and South and ye lines of Latitude East and West

These papers gave occasion to some discourse concerning the motion of Projecta it was thought not improbable both by Mr President & Mr Caswell, that the Air does make a greater resistance against quicker bodies, than against those, which are slower, *cæteris paribus*

A Letter from Mr Cole of Bristoll dated July 18 and correcting a mistake in a former letter of his concerning ye measure of a Virginia Catskin in his custody, was read

A Letter from Mr Ash dated Trin Coll (Dublin) July ye 12th was communicated and read it contain'd a letter of Sr R Buckley's which gave a full description of ye new Calesh used by him this last letter is sent ye Royal Society

Dr Plot proved that not onely Box of ye English woods sinks in water, for Elder if you cut off ye pith & the rind, does ye same, as we saw ye black Walnut of Virginia was seen to sink

The measure of the hand of a monstrous Irish man, shewn lately at Oxford, was communicated by Dr Plot, He was 7 foot 6 inches high, ye length of his span 14 inches, of his Cubit 2 foot 2 inches of his Arm 3 foot 2 inches ½, from ye shoulder to ye crown of his head 11¾ His name Edmund Melloon, aged 19 years Anno 1684, born at Port Leicester in Meath Upon this occasion Dr Plot discoursed on ye extravagant proportion of parts in men of an extraordinary size especially after sicknesse concerning which he was desired to draw up his thoughts against ye next meeting

July 29, 1684 An Account was brought in, of ye Ecclipse of ye Sun, on July 2, 1684, ye Observations were taken in ye University Observatory, by Dr Wallis, Mr Bernard, Mr Caswell, and Mr Rooke

Dr Plot presented ye Society with an Elf Arrow, brought from within two, or three, miles of Edinborough, where they are in great plenty He shewed also some naturall gold of Scotland in a pepin, or great grain, and he also communicated an account of Black Lead found onely in Keswick in Cumberland, and there called Wadt, or Kellow

Mr Musgrave acquainted ye Society, that he had lately repeated ye experiment mentioned in ye Minutes of June 24th 1684, tying and cutting of, ye externall Jugulars of a dog, with ye same success as formerly, ye dog in neither of these experiments being any way concerned at ye stoppage of ye circulation in these veins

Societies and Academies

LONDON

Geological Society, June 10 —L R **Cox** The fauna of the basal shell-bed of the Portland Stone of the Isle of Portland On the western coast of the Isle of Portland the basal bed of the Portland Stone is a highly fossiliferous shelly limestone, on the surface of which fossils weather out in an extremely good state of preservation The specimens described were collected by Lieut -Col R H Cunnington and include about 80 species of mollusca of which 18 lamellibranchs and 9 gastropods are new to science, and several others have not before been recorded from Great Britain —H L **Hawkins** Echinoidea from the Portland Stone and the Purbeck Beds Before last year only one species ('*Echinobrissus*' *brodiei* Wright) was known from the Portland Stone A species of *Hemicidaris* from the sands was the only other echinoid recognised in the British Portlandian The work of Lieut -Col Cunnington has revealed three specimens of "*E* ' *brodiei* in the basement-bed of the Portland Stone (and one from the overlying Whit-Bed), and material for the study of four other species with indication of a sixth Prof Hawkins has also found *Hemicidaris purbeckensis* Forbes in the Middle Purbeck Series of Durlston Bay, near Swanage, which was collected from that locality about 75 years ago but not since, and specimens of an apparently new form referable to 'Pseudodiadema *sensu latissimo* The irregular distribution of echinoids in these and other Jurassic strata may be due to the known tendency of echinoids to live in restricted clusters (comprising several species of similar ecological quality) which seem to migrate wholesale in successive generations —E **Spencer** On some occurrences of spherulitic siderite and other carbonates in sediments The spherulites occur in association with fine-grained sediments of carbonaceous, muddy, or silty type, often with comminuted plant-tissue, and are fairly uniform in size locally The deposits seem to be of freshwater origin and devoid of calcareous shelly remains, the carbonate material in most cases consists of nearly pure siderite The occluded sediment is similar to that in which the spherulites are embedded, where "zoning of the sediment occurs it is subordinate to radial structure The spherulites probably formed from iron-carbonate solutions held within the gradually settling and consolidating sediment The reactions resulting from the presence in sediments of humate compounds, salt, calcium carbonate, etc, are considered The iron compounds present in solution in fresh water were probably adsorbed by the fine-grained and partly colloidal sediments and carried down with them during deposition Supersaturation would result from the settling and flocculation of the sediment, and from the gradual upward expulsion of the more readily diffused water-molecules Crystallisation would then commence at a number of centres simultaneously

Optical Society, June 11 —E F **Fincham** The changes in the form of the crystalline lens in accommodation According to Helmholtz, the lens swells and increases in convexity during accommodation because the tension upon it is relaxed when the ciliary muscle contracts In order to explain the change of the anterior surface of the lens to a hyperbolic form in accommodation, Tscherning states that the tension of the lens is maintained when the muscle contracts, and the forms of the surfaces are altered by a pressure by the vitreous humour exerted

upon the periphery of the posterior lens surface. The radii of curvature of both anterior and posterior surfaces of the lens, and also the movement which the apices of these surfaces make in accommodation, have now been measured. In two selected cases of men of the same age and having the same refractive error, considerable differences in the behaviour of the lens in accommodation were found. For a given amount of accommodation, whereas the lens surfaces in one case are more increased in curvature than in the other, their apices suffer less movement; the surface which was most altered in curvature showed the most pronounced hyperbolic form in both relaxed and accommodated conditions. The results can be explained by the Helmholtz theory, by taking into account the properties of the lens capsule.—C. V. **Raman** and K. **Banerji**: The optical properties of amethyst quartz. A section-plate of amethyst cut normal to the optic axis, when viewed under suitable conditions, without a polariser or analyser, shows coloured diffraction fringes of the Fresnel type arranged periodically and running parallel to the lines of the structure. The diffraction effect is due to the periodic change of phase produced by the structure and not to any periodic variation of transparency. The diffraction spectra of the Fraunhofer type due to the structure may also be observed. The plate is thus in effect a phase-change diffraction grating.—R. S. **Clay** and T. H. **Court**: A Lucernal microscope by Samuel Washbourn, London. The instrument, which was probably made in 1800, has adjustments for focussing and for moving the object in two directions at right angles to one another. The objectives, consisting of single lenses, are mounted in a vertical slide so that different powers may be used. All the adjustments can be made from the eyepiece end. The instrument can readily be taken to pieces and the parts fit into a case, suggesting that it was originally used by a peripatetic lecturer.

Physical Society, June 12.—G. **Temple**: On mass and energy. It is assumed that variations in the potential energy of a body (gravitational or electrostatic) are always accompanied by proportionate changes in its mass. Continuing this assumption with the theories of Newtonian dynamics and Maxwellian electrodynamics, it has been found possible to predict all those phenomena, which are usually regarded as the crucial tests of the theories of relativity, both "special" and "general".—E. **Tyler** and E. G. **Richardson**: The characteristic curves of liquid jets. Continuing the work of S. W. J. Smith and H. Moss upon the relation between the length of a capillary jet and its velocity of efflux from a cylindrical orifice, further examination has been made of the causes to which the main features of the curves obtained by these authors are due. Such curves consist of two main branches. In the first, with increasing velocity, the jet length rises until a critical point is reached. In the second, which begins at this point, the jet length diminishes rapidly with further increase of velocity. The results now obtained indicate that while surface tension is of prime importance in the first parts of these curves viscosity is the dominating factor in the second.

Royal Statistical Society, June 16.—F. **Shirras**: Taxable capacity and the burden of taxation and public debt. The national income of Great Britain and Northern Ireland in 1924 is estimated at 3850 millions sterling. At the end of 1919 it was between 4000 and 5000 millions sterling. The national income of France for 1924 is estimated at 164 milliard francs; of Germany, for the end of 1924, at least 30 milliards of gold marks; of the United States in 1924 60,000 million dollars. Taking the percentage of taxation to the total net income the following figures are for 1923 or 1924; those in brackets being the pre-War year figures: Germany, 26 per cent (11.8 per cent); Great Britain and Northern Ireland, 22.1 (11.4); Japan, 21.8 (18.2); Canada, 19.2 (13); Australia, 18.4 (10.4); France 17.8 (13.8); Austria, pre-War, 15 per cent, and the 1924 figure indicates that taxation is probably heavier than before the War; United States, 10.5 (6.5); and India, 5.1 (4.4).

DUBLIN

Royal Irish Academy, June 8.—J. J. **Nolan** and J. **Enright**: Preliminary account of observations on the size of raindrops. Raindrops of radii from 2 to 45×10^{-3} cm. have been accurately measured. This range covers the interval between the observations of Defant on raindrops and those of Kohler on mist-particles. The smaller drops are found in very great numbers. Certain sizes appear to be specially prominent, but further observations are necessary to test the reality of this prominence.

EDINBURGH

Royal Society, June 8.—Sir Alfred **Ewing**: A ball and tube flow-meter. The device provides a visible measure of the rate of flow of a liquid through any pipe system without interfering with the flow. It consists of a slightly tapered straight glass tube to which a scale is attached. Within the tube is a ball which is a loose fit at the bottom, and round which there is a considerable clearance as the ball is forced up in the tube. The tube is placed in a sloping position with the narrow end down and the liquid flows up towards the wider end. The stream carries the ball up along the tube until a position is reached where the clearance round the ball is such as to suit the particular rate of flow. The position of the ball is read off on the scale and from that position the rate of flow is determined. The sustaining action of the moving stream upon the ball is due to two causes: an inertia effect caused by the development of turbulence in the region above the ball, and an effect of viscosity by which the stream produces an upward drag in passing over the ball. By experiments with two fluids the relative magnitude of the two effects was determined. The device is being adapted by the Engineering Committee of the Food Investigation Board to indicate the circulation of the working fluid in the cycle of a refrigerating machine.—General **Ferrie**: Maintenance of clocks by means of photoelectric cells. The pendulum to be maintained in oscillation is mechanically entirely free. A small mirror is attached near the top of the rod and a permanent horseshoe magnet to the foot. Light falling on the mirror is reflected in the vertical position of the pendulum to a photoelectric cell. The electron current is amplified, and passes round a solenoid which engages one arm of the horseshoe magnet attached to the pendulum in a suitable position and maintains the motion. Complete syntony is thus realised.—W. **Peddie**: A spectrometer designed specially for investigations regarding colour vision. A single slit is used and the collimator lens, being divided into halves diametrally, gives two images which are formed on a diffusion plate and so act as the two slits with a single source. A second split lens parallelises the light from these images and gives, by suitable sliding of the halves,

on passage through a prism and an object glass of a telescope, four partially superposed spectra two of which can be exactly superposed A slit at the focus of the telescope allows a portion of the three independent spectra to pass through, and the wave-lengths transmitted may be adjusted suitably for compounding red green, and blue lights With weaker illumination the diffusion plate is omitted and a biprism is placed behind each half of the second split lens —J **Forrest** A new method of discriminating the arrangement of the molecules in a crystal High magnetic fields are used Theory gives an estimate of the variations of the internal magnetic force in a crystal when the external magnetising field takes all possible orientations about the substance, which is regarded as composed of a regular array of molecular magnets The components of force parallel and transverse to the field are dealt with, and positions of maxima and minima of these are predicted in any convenient plane of the crystal for any possible lattice arrangement of the centres Some weakly magnetic crystals were investigated experimentally and give good agreement with the results of X-ray measurements Different lattices can be compared with respect to their stability, dealing with the internal magnetic energy of regular arrangements of molecular magnets which are co-directed or randomly oriented —D A **Fairweather** The electrosynthesis of *n*-duotriacontane dicarboxylic acid This acid, containing a chain of thirty-four carbon atoms is the highest member of the series of normal dibasic acids so far prepared Its di-ester was obtained by electrolysis of sodium ethyl hexadecane dicarboxylate —W L **Ferrar** On the cardinal function of interpolation theory The relation of the series defining the function with other types of expansion is considered in particular, its relation with the Gauss formula The convergence of the latter implies the summability of the former (by de la Vallee Poussin s method) to the same sum

PARIS

Academy of Sciences, June 22 —G **Bigourdan** The systematic errors which may affect the pendulum corrections employed at the B I H —V **Grignard** and R **Escourrou** The catalytic hydrogenation of the nitriles under reduced pressure A method for the synthesis of the aldimines The activity of the catalyst is reduced by working under reduced pressure With oxide of platinum on pumice as catalyst, at 200° C and under a pressure of 220 mm benzyl cyanide is completely reduced to the aldimine $C_6H_5CH_2-CH-NH$ at one passage Benzonitrile undergoes a similar reduction —C **Sauvageau** The naturalisation in France of the Australian *Asparagopsis armata* Its iodine reserves There would appear to be some free iodine in this plant —Leon Guillet was elected a member of the division of the applications of science to industry in succession to the late Charles Rabut —J **Haag** Certain asymptotic probabilities —C **Valiron** Meromorph functions which are exceptional relatively to the theorem of M Julia —V **Romanovsky** Certain mathematical expectations and on the mean error of the coefficient of correlation —E **Huguenard**, A **Magnan** and A **Planiol** A method of studying the inertia effects resulting from the operations of steering aeroplanes —A **Lafay** The deviations of the thrust of the wind, on a cylinder, produced by a sheet of air impinging tangentially to the surface of this body —F **Zerner** The entanglement of the ether and the aberration of the stars —P **Chofardet** Observations of the Tempel II comet (1925*d*, Stobbe) made at the Besançon Observatory with the 33-cm equatorial Positions of the comet and comparison stars are given for June 15, 16 18, 19 It was seen as a rounded nebulosity of about the 12th magnitude with a small central nucleus —G **Rougier** Observations of the Tempel II comet (1925*d*) made with the 49-cm equatorial of the Observatory of Strasbourg Position given for June 16 —Mlle **Berenger** and A **Tian** Heats of solution and heats of incomplete reactions —C **Gutton** and E **Pierret** The harmonics of oscillators with very short waves —G **Foex** and L **Royer** The diamagnetism of nematic substances —A **Dufour** The classical calculation of the Michelson experiment on the hypothesis of an immobile ether —Mlle J **Liquier** The variation of the rotatory power of solutions of asparagine as a function of the hydrogen ion concentration Whatever acid be added the rotation is the same for a given hydrogen ion concentration On the hypothesis that there is present a mixture of non-dissociated molecules and the corresponding ions, the rotatory power can be expressed quantitatively as a function of the hydrogen ion concentration and the two dissociation constants of asparagine The theoretical curve so derived coincides closely with the experimental figures —Th **Vautier** The secondary waves produced by an aerial wave —Th de **Donder** The calculation of specific affinity —Jean **Barbaudy** The boiling-points of mixtures of water, benzene, and ethyl alcohol under a pressure of 760 mm of mercury The whole of the experimental results are shown on a triangular diagram The minimum boiling-point given by Young is confirmed —P **Chevenard** The dilatometric anomaly of the α solid solutions of copper and aluminium —T **Batuecas** Revision of the weight of the normal litre of methyl chloride gas The methyl chloride was prepared by two independent methods the interaction of phosphorus trichloride and methyl alcohol and by the pyrogenic decomposition of tetramethylammonium chloride The mean of seventeen determinations is 2 3084 appreciably greater than the value given by G Baume, 2 3045 —P **Job** The spectrographic study of the formation of mercuric complexes —E **Rouyer** The association of the polyphenols —J **Bardet** and C **Toussaint** The separation of celtium, and the arc spectrum of this element In the separation of zirconium and celtium a good method can be based on the difference of the solubility of 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colour, form and structure of the mosses are modified by the intensity of the light to which they are exposed With diminution or suppression of the light, the distinctive characters from which several species take their names disappear —Mlle France **Gueylord** and P **Portier** The ionic reaction

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Official Publications Received

Report for 1924 on the Lancashire Sea Fisheries Laboratory at the University of Liverpool and the Sea Fish Hatchery at Piel Edited by Prof James Johnstone Pp 136 (Liverpool)

Experimental and Research Station, Nursery and Market Garden Industries Development Society Limited Turner s Hill, Cheshunt, Herts Tenth Annual Report 1924 Pp 104 (Cheshunt)

Meteorological Office Air Ministry Advisory Committee on Atmospheric Pollution Report on Observations in the Year ending March 31st 1924 Forming the Tenth Report of the Committee for the Investigation of Atmospheric Pollution (M O 270) Pp 53 (London H M Stationery Office) 4s net

Annual Conference of the Universities of Great Britain and Ireland, 1925 Report of Proceedings Pp 60 (London Universities Bureau of the British Empire) 1s

Conseil Permanent International pour l Exploration de la Mer Publications de Circonstance No 86 A Recording Current Meter By H J Buchanan Wollaston Pp 14 Publications de Circonstance No 87 L emploi de l eau normale dans l oceanographie Par Martin Knudsen Pp 11 (Copenhague Andr Fred Høst et fils)

Proceedings of the Royal Society of Edinburgh Session 1924–1925 Vol 45, Part 3 No 21 Rejuvenation of the Aged Fowl through Thyroid Medication By F A E Crew Pp 252 260 Vol 45 Part 3 No 22 L Entretien des pendules au moyen de cellules photo electriques Par M le General G Ferrie Pp 261 268 (Edinburgh R Grant and Son, London Williams and Norgate, Ltd) 1s each

Forestry Commission Fifth Annual Report of the Forestry Commissioners, Year ending September 30th, 1924 Pp 43 (London H M Stationery Office) 1s net

The Society for Promoting Scientific Knowledge A Review of Activities during 25 years 1900-1925, and Twenty fifth Annual Report Pp 46 (Lahore)

United States Department of Agriculture Department Bulletin No 1328 The Flight Activities of the Honeybee By A E Lundie Pp 38 10 cents Department Bulletin No 1332 Emulsions of Wormseed Oil and of Carbon Disulfide for destroying Larvae of the Japanese Beetle in the Roots of Perennial Plants By B R Leach and J P Johnson Pp 18 5 cents (Washington Government Printing Office)

New South Wales Department of Mines Geological Survey Bulletin No 6 The Coal Resources of New South Wales By the Staff of the Geological Survey Pp 154+12 plates 2s 6d Bulletin No 9 Limestone, Dolomite, Lime, and Hydraulic Cement By Leo J Jones Pp 37+7 plates 2s 6d Bulletin No 16 Barytes, Ochres and Oxides By H G Raggatt Pp 16+2 plates 1s (Sydney Alfred James Kent)

Memoirs of the Indian Museum Vol 8 No 2 Revision of the Indian Ampullariidae By Dr B Prashad Pp 69 89+plates 13 15 (Calcutta Zoological Survey of India) 3 rupees

Aeronautical Research Committee Reports and Memoranda, No 962 (Ae 178) Discontinuous Flow around the Edge of a Bluff Obstacle By L W Bryant and D H Williams (A 1 b Photographic Work, etc , 9 —T 2008) Pp 4+11 plates (London H M Stationery Office) 1s net

Cornell University Agricultural Experiment Station Memoir 68 The Lepidoptera of New York and neighboring States, Primitive Forms, Microlepidoptera Pyraloids Bombyces By William T M Forbes Pp 729 (Ithaca, N Y)

Ministry of Agriculture Egypt Technical and Scientific Service Bulletin No 58 The Survival of Pink Boll Worm Larvae in Buried Seed during the Winter in Egypt By C B Williams and Ibrahim Eff Bishara Pp 7+2 plates (Cairo Government Publications Office) 5 P T

Report of the Aeronautical Research Institute Tokyo Imperial University Vol 1, No 10 The Inertia Forces and Couples and their Balancing of the Star Type Engine By Keikichi Tanaka Pp 247 304 (Tokyo Maruzen Kabushiki Kaisha) 1 10 yen

Field Museum of Natural History Botanical Series Vol 4 No 4 South American Plants, by J Francis MacBride also New Euphorbias by C F Millspaugh and Canavalias by C V Piper (Publication 231) Pp 79 95 (Chicago)

A Cotton Research Station for the British Empire Being a Summary of a Report to the Empire Cotton Growing Corporation By Prof J B Farmer and L G Killby Pp 23 (London Empire Cotton Growing Corporation)

The Faraday Society Report of the Council and Statement of Accounts to be presented at the Annual General Meeting July 6th 1925 Pp 11 (London The Faraday Society)

Smithsonian Miscellaneous Collections Vol 75, No 3 Cambrian Geology and Paleontology, V No 3 Cambrian and Ozarkian Trilobites By Charles D Walcott (Publication 2823) Pp 59 146+plates 15 24 (Washington Smithsonian Institution)

Diary of Societies

SATURDAY, July 25

Aristotelian Society, Mind Association, and Oxford Philosophical Society (Joint Session) (at Balliol College Oxford), at 10 A M —C R Morris, Dr Dorothy Wrinch, and Prof L J Russell Symposium The Concept of Energy —At 2 30 —Dr Ivy Mackenzie The Biological Basis of the Sense of Time —At 8 30 —Prof J A Smith, Prof A D Lindsay, and Dr F C S Schiller Symposium Croce s Theory of the Practical Nature of Science

SUNDAY, July 26

Aristotelian Society, Mind Association and Oxford Philosophical Society (Joint Session) (at Balliol College, Oxford), at 2 30 —P E More, Prof W D Ross, and Prof G Dawes Hicks Symposium Plato and Aristotle —At 8 30 —J MacMurray, C E M Joad, and A H Hannay Symposium Is Art a form of Expression or of Apprehension ?

MONDAY, July 27

Cambridge Philosophical Society, at 4 30

NATURE

SATURDAY, AUGUST 1, 1925

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The Future of the British Patent Office

II

IN investigating in Great Britain the novelty of an invention, the Patent Office confines its search to British specifications published within the previous fifty years, and we have suggested that the search should be extended to cover text-books, periodicals, and foreign specifications, the period of search being restricted to twenty years except in the case of British specifications and text-books The foreign specifications to be considered would be those published in the Dominions, France, Belgium, Germany, the United States, and Switzerland, for few inventions of serious importance will fail to be protected in one or other of these countries We have now to estimate the increase of staff and of cost which this innovation would involve, and to show that the expense can be met by practicable means

The machinery for the present search amongst British specifications was evolved by the scientific section of the Patent Office staff after many trials, and its success suggests that the devising of extended machinery must be left in the same hands In order, however, to estimate what is involved in the present proposals, it will be necessary to consider in outline the form which that machinery would probably take The characteristic feature to which the British search owes its thoroughness is the use of abridgments, so that the first step would be the abridging of the specifications published within the prescribed period in the countries we have mentioned, with the exception of New Zealand, Australia, and Belgium, for which countries abridgments are already available Since the same inventor will often protect his invention in several different countries, many duplicates will be found in order to sort these out and bring them together, by the aid of the inventor's name, the title, and the general aspect of the drawings, a small clerical staff would be necessary For the actual work of abridging specifications in French and German the use of translators is to be deprecated, for it is both uneconomical and unsatisfactory in its results Each class of subject-matter should preferably be indexed and abridged by the examiner, or syndicate of examiners, familiar with that class, so that it will be necessary for each syndicate to contain some one familiar with French and German This should not be difficult, since most scientific men already know at least one of these languages

As regards literature, text-books and year-books present little difficulty as they are usually provided with indexes, and examiners would soon become familiar with those which relate to their particular classes Weekly and monthly periodicals and irregular publications such as bulletins are, with few exceptions, devoted

to a very restricted range of subject-matter the examiner concerned with any such periodical would make extracts from it for his card index, the shorter extracts by means of manuscript notes and the longer extracts by means of underlined press-cuttings The more general periodicals would have to be circulated to a number of examiners, but in most cases it would be sufficient to arrange that a single primary examiner should read each issue, passing on to the appropriate colleague any subject-matter for which he could not himself account satisfactorily

We have now to estimate the increase in staff which would be necessary in order to carry out a search of the extent and thoroughness proposed Let us consider first the state of things which will prevail when all preparatory work has been completed and only current work is being dealt with We must compare the work of dealing with the specifications published annually in the countries we have mentioned with the annual work done on British specifications by the present staff, and for this purpose we shall assume that an examiner spends one-fifth of his time in abridging and indexing, one-fifth in actually searching, and the remaining three-fifths in general examination, attending to amendments, interviews, and provisional specifications, preparing for hearings, improving the classification of search material, studying law reports and technical literature, and other miscellaneous duties We shall assume further that the time spent in reading, indexing, and abridging a specification would be halved in the case of foreign specifications, for since no general examination is to follow in their case, a far less meticulous reading would suffice than in the case of British applications, and we shall assume that the rate of searching could be increased by increasing the number of sub-headings under which inventions are classified There are no statistics to support these assumptions and they are open to debate, but it can be said in their favour that they appear reasonable, and further, that the actual time spent in these tasks can be controlled, since the standard of thoroughness is necessarily somewhat arbitrary

These assumptions, then, give us a measure of the additional staff necessary to abridge, index, and search through a given number of additional specifications, and we must turn next to the statistics of specifications published abroad In doing so, however, we must allow for duplicates, for (to give only two examples) 65 per cent of Canadian patents are granted to residents in the United States, 7 per cent to residents in Great Britain, and only 16 per cent to Canadians while of British patents 58 5 per cent are indigenous, 28 5 per cent are granted to residents in the other countries we have mentioned, and the remaining 13 per cent are granted to residents in Sweden, Holland, and other countries not mentioned (These figures relate to the year 1922) It is safe to assume that every applicant will have applied for a patent in his own country, so that in estimating the number of foreign specifications per annum we may eliminate duplicates by counting only indigenous patents The resulting figure will be a little too small, but sufficiently accurate for our present purpose The latest complete statistics are for the years 1921 and 1922, and taking the mean of these two years as a basis, the annual output of unabridged indigenous published specifications is as follows Canada 1610, South Africa (estimated) 340, India 263, France 10,394, Germany (estimated) 14,500, United States 33,941, Switzerland 1907, total 62,955 This total we must compare with the mean number of specifications abridged annually by the present examining staff during the same period This figure is not accurately known, as not all specifications which have been abridged are published, but it cannot be far short of 19,000 At this rate the new material to be abridged annually will be about 3 3 times the material at present abridged annually, so that on the basis already explained we must increase the staff by 33 per cent on this account

New Zealand publishes about 360 indigenous patents per annum, Australia 2600, and Belgium 6000, but as these are already abridged the work of indexing them, at the rate of about 1 per fortnight per examiner, need not be taken into account As regards the time spent in searching amongst foreign patents, the search material would be increased by the specifications published in the countries mentioned during the previous twenty years, the total being about 1,750,000, but to allow for duplicates this must be reduced, in the general ratio of indigenous to total patents, to 1,250,000 The latter figure must be compared with the number of British patents at present in the search files and covering a period of fifty years that number is about 550,000, so that the search material will be increased by about 228 per cent, and on the basis we have adopted this means a further increase of 23 per cent in staff to allow for the extra time spent in searching

As regards literature, we pass over text-books and year-books because, as has already been pointed out, the staff can take these in its stride Of the 1759 weekly, monthly, and irregular periodicals taken by the Patent Office Library, a considerable proportion is devoted to non-patentable subject-matter Of those which contain search material it has been estimated that there are very roughly 18,000 issues per annum, a number of the same order as the number of British specifications filed per annum To determine the average content of an issue would require a very elaborate research, for some periodicals, such as papers on wireless, contain a good deal of subject-matter, while others, such as agricultural

papers, rarely contain any reference to invention, and mere quotations from specifications could, of course, be ignored On the whole, we shall be fairly safe if we say that one average issue contains as much subject-matter as one average specification, and at this rate we must allow a further increase in staff of 10 per cent on account of indexing periodicals and 7 per cent on account of searching them for the past twenty years This gives a total increase of 73 per cent in the staff, if we make no allowance for time to be spent in visiting factories

We turn next to the preparatory period which must elapse before a universal search could be undertaken The preparatory work would include (1) the improvement of the classification by increasing the number of headings, (2) the training of the new staff and reorganisation of the staff as a whole, (3) the abridging and indexing of the periodicals and foreign specifications published during past years The last item is the most serious, and is the only one which we shall take into consideration here If merely the additional 73 per cent of staff were to be engaged some time before the institution of the search for the purpose of carrying out the work of preparation, there would be a delay of 12 years before the search could begin, so that in addition to increasing the establishment by 73 per cent it would be necessary, in order to shorten this delay, to engage a temporary excess of, say, 23 per cent of the then establishment This would enable a search to be begun five years after the engagement of the new staff and covering a period of thirteen years three and a half years later the full period of twenty years could be searched, and there would then be a redundant staff of 23 per cent, which would be absorbed by normal wastage in six or seven years If a larger excess staff were engaged in the first instance the search could be undertaken at still shorter notice, but the capital cost would, of course, be increased Against this capital cost must be set off, in any case, the saving due to the fact that the new staff would enter the office on the lowest rung of their salary scale

Great Britain is spending some 466,000,000*l* in the relief of unemployment, largely by methods admittedly uneconomic Little is being spent in the relief of unemployment by the stimulation of new manufactures on the contrary, the inventor has to pay for the whole cost of the patent system and to pay upwards of 75,000*l* a year in addition, in relief of general taxation, whereas in 1924, the United States thought it worth while to spend on her patent office 408,602 dollars out of her exchequer These facts must be borne in mind in considering the question of the annual cost of the proposed extended search The chief item will be the annual salaries of the additional staff, and we must estimate these not at the initial rate of salary at which new entrants will take up their duties, but at the average taken over their whole official career, which will be considerably higher We may assume that this average will be equal to that for the present examining staff, so that if we take the aggregate salary of the latter, excluding Hearing Officers, and multiply it by 0 73, we shall arrive at the normal increase in annual expenditure on this account The result, as estimated from the Comptroller's Report for 1924, amounts roughly to 106,400*l* per annum, and to this we may add 3000*l* for clerical and other supplementary staff, 5000*l* for purchase of documents, and 7000*l* for buildings, furniture, and maintenance, giving a total of 121,400*l* per annum

How is this additional expenditure to be met? We may put aside for the moment the suggestion that the whole cost of the patent system might be transferred to a tax on the sale of patented articles, and turn to more conventional sources of revenue In the first place, the Patent Office makes a profit of 75,000*l* a year There is no justification whatever for this profit it is a direct tax for the discouragement of invention, and only persists because it has been no one's business to attack it effectively We may assume, then, that this profit can be abandoned, as the community's contribution to the cost of a scheme which is to benefit it considerably Next, the maximum normal life of a patent might be extended to twenty years instead of the present sixteen For the older patents the yield from renewal fees in respect of the *n*th year is given in pounds sterling by the formula $1\ 7 \times 10^{5-0\ 072n}$ with such accuracy that we may venture to extrapolate for the four years following We thus find an additional yield of 32,000*l* per annum from this source, leaving 14,400*l* still to be found As some 17,000 patents are sealed per annum, the addition of 1*l* to the sealing fee is consequently the only increase in fees which would be necessary in order to balance the Patent Office budget

In order to justify the preceding calculations it is necessary to examine rather carefully the effect of an increase in fees on the annual output of inventions It may be supposed that such an increase will tend to diminish the output of inventions, while the enhanced value of the patent when granted will tend to augment it, so that some doubt arises as to the net effect All experience goes to show, however, that a small change in fees has a negligible effect When the present very limited British search was introduced in 1905 and at the same time the sealing fee of 1*l* was added to the cost of the British patent, no change at all took place in the annual number of applications, while, on comparing the triennium 1902–4 with the triennium 1906–8, we find that the annual number of complete specifications increased by 17 5 per cent, and the annual number of

patents sealed increased by 6 per cent In the United States the application fee was increased in 1922 from 15 dollars to 20 dollars, the final fee of 20 dollars remaining unchanged and no *quid pro quo* being offered by way of increased value in the patent yet if we compare the preceding years 1919–21 with the following years 1923–4, we find that before the change the United States had 2 54 times as many applications as Great Britain, and after the change 2 50 times as many, a drop of only 1 6 per cent

Then again, the scales of fees are very different in Great Britain, Germany, and the United States, yet the output of inventions per head of the population is roughly the same in each of these countries Thus in Great Britain there is an application fee of 1*l*, a "complete" fee of 3*l*, and a sealing fee of 1*l*, or a total initial fee of 5*l*, followed by an increasing scale of renewal fees for the fifth and later years In Germany there was until recently an application fee of 6 gold marks and an examination fee of 8 gold marks, or a total initial fee of 14 gold marks (about 14*s*), followed by an increasing scale of renewal fees from the second year onwards In the United States there is an application fee of 20 dollars and a final fee of 20 dollars, or a total of 40 dollars (8*l*), but there are no renewal fees at all It might be expected, therefore, that the output of specifications would be very different in the three countries, yet if we take the official figures on this subject for the year 1923 and compare them with the populations as given in the latest Whitaker's Almanack, we find the following result Applications per thousand of the population in Great Britain, 0 69, in Germany, 0 75, in the United States, 0 76 Complete specifications filed per thousand of the population in Great Britain, 0 40, in Germany, 0 38, in the United States, 0 39 All these figures go to show that within reasonable limits fees have very little effect on the output of inventions

Mr Churchill has said that an overwhelming case can always be made out for doing nothing To institute an extended search such as we have described would be a large undertaking, and one which is sure to encounter the opposition of a good deal of natural inertia Yet at the present time the British patent system is like an unfinished house, and if the figures we have given are of the right order, there is no serious reason why it should not be provided with its roof We have shown that if a substantially universal search be undertaken within five years, the Patent Office can still balance its annual budget without increase of fees, except for the addition of 1*l* to the sealing fee It is for those who would benefit by the institution of such an extended search to press upon the Government the importance of this method of stimulating invention and industry

Technical Problems of the Painter's Art

Papers of the Society of Mural Decorators and Painters in Tempera Second volume, 1907–1924 Edited by John D Batten Pp v+134+6 plates (Brighton Printed for the Society by the Dolphin Press, 1925) 10s 6*d*

THE Society of Mural Decorators and Painters in Tempera is to be congratulated on having produced a volume of fascinating interest to those who are intrigued by the practical problems of the painter The trouble is that it suggests so many queries, criticisms, and comments and opens up so many lines of inquiry that it requires a volume rather than a brief article for adequate treatment

The painter of pictures and of wall decorations of to-day is in the unfortunate position of having lost invaluable studio traditions and having to rely on obscure and doubtful records of old methods of painting The Tempera Society is, therefore, on the right lines in trying to bring together the experience of the painter, the information to be obtained from ancient records and the critical examination of old pictures, and in addition, the knowledge of the man of science When all this has been done, the difficulty remains that there are many problems that can be solved only by the study of the slow but inevitable action of oxygen, of moisture, of light, and possible internal changes in the materials themselves through long periods of time

All the publications in this volume are not new to those who are closely in touch with the subject, but they are none the worse for being reprinted, the papers by Mr Neol Heaton on the frescoes at Knossos and by the late Sir George Beilby on lime putty being of special interest Mr Tudor Hart is also to be congratulated on his excellent recipes for preparing egg and size emulsions He has had much experience in the use of these mediums The systematic and scientific study of emulsions which is at present in progress in many laboratories must ultimately prove of the utmost value to the painter in the egg or tempera medium, and the modifications of it produced by the addition of drying oils and varnishes

There are two urgent problems before the painter to-day One is the problem of wall decoration under modern conditions of air laden with coal smoke and oxidation products of sulphur dioxide It is admitted that painting with selected pigments mixed with water on wet lime has proved the most permanent method of wall decoration under suitable conditions, and it has an æsthetic value which is not obtainable by an oily medium no matter how much the oiliness of oil is suppressed by the addition of wax, but it

is obviously peculiarly liable to attack and injury under the atmospheric conditions existing in our modern cities, and it is at any rate open to question whether the northern tradition was not in favour of the use of oil, as shown by the early records of the purchase of painting materials both at Westminster and Ely. Mr. Tristram, who has been cleaning the tombs at Westminster, gives his verdict in favour of size either emulsified with or afterwards varnished with oil. I had the opportunity of examining some tiny samples from the Westminster tombs and can confirm the presence of oil, which shows that in the north there was no objection to an oil effect on decorated stone. I also found azurite, the native copper carbonate blue, and in that connexion a curious technique, namely, a layer of white lead in oil next the stone covered with a gesso containing vegetable fibre, suggesting that it was considered necessary to protect the azurite from any possibility of damp coming from the stone.

I am disposed to think we should boldly accept an oil technique for wall decorations under modern conditions. Where Buon Fresco can be used safely, it is supreme; and if we ultimately adopt scientific methods of heating, its revival should be possible even in the cities of this country. But even in this technique there are still unsolved problems. Pliny and Sir Arthur Church both agree in throwing doubt upon the use of certain yellow ochres in Buon Fresco. Mr. Burton suggests Perigord Ochre, but further inquiry and research are necessary.

The other problem facing the painter to-day is the correct use of the oil medium in the painting of pictures. Artists complain of premature cracking which occasionally occurs, and more generally of a lowering of tone from which some painters suffer much more than others. The Tempera Society in its return to the egg medium of the Italian painters of the thirteenth, fourteenth, and fifteenth centuries, represents a revolt from oil, which, owing to its facile easiness as a medium, leads to reckless use and consequent trouble.

The researches of Prof. Eibner, of Munich, have done much to put us on the right lines for solving the problem of cracking. The lowering of tone is due to the neglect of the study of the optical properties of the dry oil film of increasing age, and the reaction of these optical changes on the optical properties of the pigments. When we possess as complete a knowledge and mastery of the optical as well as of the chemical properties of the oil mediums as was possessed by Van Eyck and his followers, we shall find the solution to both these problems.

By a return to the combined tempera and oil technique, along with a thorough understanding of the optical properties of the oil film and its effect on pigments, and the obtaining in addition of a reliable backing for our pictures, better than canvas primed in the usual way, will be found, I hope, a way out of our difficulties.

In the meantime, all praise to the Tempera Society for its courageous attack on these problems. My only criticism is that they are not availing themselves sufficiently of the services of the chemist. The excellent work done, as revealed in this publication, by Burton, Noel Heaton, and Beilby, shows how much more we could do in the way of advice, criticism, and caution, and we are all anxious and willing to help.

The Society has already widened its remit so as to include wall decoration. Might not room also be found for the contemned oil medium?

A. P. LAURIE.

Geophysics in France.

Traité d'électricité atmosphérique et tellurique. Publié sous la direction de E. Mathias par J. Bosler, Dr. P. Loisel, Prof. R. Dongier, Prof. Ch. Maurain, G. Girousse, Prof. R. Mesny. (Comité Française de Géodésie et de Géophysique. Publications de la 6e Section.) Pp. xx+580. (Paris: Les Presses universitaires de France, 1924.) 40 francs.

THE U.G.G.I. (Union Géodétique et Géophysique Internationale) is a post-War body which meets normally once in three years, and has for its props and feeders national committees of geodesy and geophysics in the countries which give their financial support. The Union is subdivided into sections, of which one known as T.M. and E. deals with terrestrial magnetism and electricity. The French national committee, being a business-like body, has corresponding sections, each apparently with its president and secretary. The section answering to T.M. and E. is known as No. 6. Its president is M. D. Berthelot, membre de l'Institut, and its secretary Prof. E. Mathias, director of Puy de Dôme Observatory. The president contributes an eloquent preface of seven pages to the volume. He explains that it represents a labour undertaken by the section at the suggestion of Prof. Mathias. The completion of so comprehensive a treatise would, as he says, require enormous labour and profound erudition on the part of any one man, and during the years required to write it fresh knowledge would accumulate. Common sense thus dictated co-operation, and in M. Berthelot's words, "Une pléiade de spécialistes distingués ont bien voulu nous prêter leur bienvaillant et désintéressé concours." The general arrangement and supervision fell to Prof. Mathias, whose devotion

to his self-imposed labours merits all respect The production of such a work must have been costly It is thus interesting to note that a subvention was received from the Caisse des Recherches Scientifiques, the president of which is M A Lacroix, permanent secretary of the Academy of Sciences An enumeration of the several authors and their contributions will give, it is hoped, some idea of the wide compass of the volume

Prof R Dongier treats of the earth's electric field, the instruments used in measuring it and the results obtained In a short note later in the volume he discusses the theory of the quadrant electrometer Prof C Maurain, Director of the Geophysical Institute, Paris, writes on loss of charge, ionisation and conductivity of the atmosphere, and on atmospheric currents and conduction Dr P Loisel discusses radio-activity of the air, with subsections on the radio-activity of the earth and of wells, and he treats of the relations of radio-active substances to the earth's internal heat Prof R Mesny deals with radio-telegraphy and atmospherics M J Bosler, Director of Marseilles Observatory, discusses earth currents (of natural origin) M G Girousse, Director of Triphasé (Nord-Lumière), deals with earth currents of artificial origin

The longest contribution, by Prof Mathias, Chap I of Part II, is a discussion of electric discharges in the atmosphere Besides St Elmo's fire, lightning of various kinds, and lightning conductors, he includes also aurora Prof Mathias also supplements the work of Prof Maurain by a discussion of the mobility of ions in the atmosphere, and the various laboratory ways of measuring it Further, he discusses rainfall electricity, and writes three supplements at the end of the volume The first and last of these, devoted respectively to the so-called black flash and to Vegard's recent work on the spectrum of aurora, are very brief The second gives an account of the writer's own recent speculations on thunder and lightning

As to the other contents, there is a copious bibliography at the end of each section, and at the end of the book an authors' index As evidence of its completeness, it may be mentioned that under the heading "Elster et Geitel" there are 39 references, and the same 39 references appear on the same page under the heading "Geitel et Elster" There is no subject index, but there is a very full table of contents

A few words must suffice for comment on the several contributions M Dongier's account of instruments for measuring potential gradient is well illustrated Chauveau is quoted as to the great superiority of photographic recorders as compared with the Benndorf electrograph In this we concur, but we should associate the former type rather with the name of Kelvin than that of Mascart Many important practical details are mentioned, including the reduction to the infinite plane Diurnal variations are represented, perhaps somewhat superficially, by numerous diagrams

The articles of Profs Maurain and Mathias on ionisation and conduction show little overlapping, and form an excellent discussion of the subject

Dr Loisel commences with a general discussion of radio-active transformations and then passes to atmospheric phenomena, including the ionisation in closed vessels In discussing Messrs Campbell and Wood's observations he accepts their assumption that the diurnal variation of potential gradient has the same character at Cambridge as at Kew This wants confirmation Dr Loisel gives a large number of data for the radio-activity of rocks and of mineral wells The bibliography at the end of his article has 122 entries

In his discussion of thunder and lightning, Prof Mathias devotes considerable space to lightning conductors, and to a historical discussion of Franklin's discovery that lightning is an electrical phenomenon The meteorological aspects, frequency and diurnal variation of thunder, are scarcely touched on Aurora is not a prominent "meteor" in France, and the survey made of it is somewhat rapid It refers, however, to Stormer's height measurements, and to the results of his mathematical calculations

In his discussion of rainfall electricity, Prof Mathias treats very fully of Dr Simpson's observations at Simla, and inclines to the opinion of Nolan and Enright that "la theorie preconisee par Simpson est pleinement competente pour expliquer les phenomenes electriques observes des orages a foudre" (p 381) Another research to which he devotes special attention is the interesting recent work of Norinder on the electric field during thunderstorms

M Mesny, after discussing the apparatus and methods of radio-telegraphy, gives much valuable information about the variation in the facility of propagation of electric waves of various lengths, about variations of azimuth, and about atmospherics In the latter topic he has many references to the work of Mr Watson Watt

M Bosler narrates the historical development of our knowledge of earth currents, and describes the means of recording them employed at the observatories of Parc St Maur and the Ebro He discusses the diurnal variations observed at these two stations and Weinstein's results for Germany Contrasting the records of earth currents and magnetic variations at Parc St Maur, he infers apparently that the latter are largely

a consequence of the former, so far at least as irregular changes are concerned

M Girousse's discussion of artificial earth currents requires some knowledge of electrical engineering for its full comprehension, but the general conclusions are easily followed What specially interests M Girousse is apparently the financially important question of the electrolysis of underground pipes

Taking the volume as a whole, British workers have no reason to complain of lack of recognition—except perhaps in the case of the thunderstorm work of Prof C T R Wilson—and their names are usually tackled successfully Lennan, however, without the "Mac," p 286, has a somewhat Bolshevist appearance In view of the present cost of printing, a similarly comprehensive work in English seems a remote contingency for years to come Physicists of the older generation owed much to the works of Deschanel and Ganot, and present-day geophysicists who read French easily will find the treatise under notice of great assistance in their studies C CHREE

Modern Entomology

(1) *Anatomy and Physiology of the Honeybee* By R E Snodgrass (McGraw-Hill Agricultural and Biological Publications) Pp xv+327 (New York McGraw-Hill Book Co, Inc, London McGraw-Hill Publishing Co, Ltd, 1925) 17*s* 6*d* net

(2) *A General Text-book of Entomology including the Anatomy, Physiology, Development and Classification of Insects* By Dr A D Imms Pp xii+698 (London Methuen and Co, Ltd, 1925) 36*s* net

IN 1910 the United States Bureau of Entomology issued a Bulletin by Mr Snodgrass on "The Anatomy of the Honeybee," which immediately attracted attention, and has since maintained its place as the authoritative work on the subject The present volume, as its title implies, has a wider scope, and contains a greater proportion of matter derived from the researches of others The additions are judiciously selected and well presented Nothing is final, but the book may stand as a fairly complete statement of our present knowledge of the morphology and physiology of this important insect, and the hope of the author that our ideas of the bee may hereby be placed "on a surer scientific basis than before" is amply justified

An interesting section deals with the senses of the bee There is no evidence that bees hear, but the senses of sight and smell are fully discussed, results published by investigators so recently as 1924 being duly incorporated As regards smell, perhaps too much space is accorded to the rather crude experiments of M'Indoo, which led him to deny to the antennæ any great importance as olfactory organs Justice is done, however, to the more convincing work of von Frisch, who was careful to use non-irritant odours under some approach to natural conditions, and who not only reinstates the antennæ, but also considers that the pore-plates of the last eight segments are the special organs of smell

The illustrations are for the most part admirable Many are, of course, retained from the original Bulletin, and some of these have become very familiar from their recurrence in all manner of zoological text-books But there are many new figures of an equally high standard of excellence One of the least satisfactory bears the legend, "Isle of Wight disease mites," but there is no reference to these parasites in the text Mr Snodgrass is not of course concerned with pathology, but if he finds room for Dr Rennie's Acarapis, it might be useful to indicate the particular tracheæ to which it is always confined

In typography and clearness of arrangement the book is all that it should be, and Mr Snodgrass has a lucid and pleasing style without a trace of transatlantic idiom, so that we need not complain if he conforms to his country's idiosyncrasy in the spelling of certain words

(2) Dr Imms has broken new ground in his "General Text-book of Entomology" The multitude of insect books published in English during the last fifty years have for the most part fallen into one of two categories There is the Nature-study variety chatty and discursive, and drawing largely from the incomparable J H Fabre, and there is the collector's hand-book variety, concerning itself entirely with the adult insect, and designed to aid the young collector in the identification of his pinned specimens Few have dared to deal with the vast subject of entomology as a whole, and if this was a staggering task fifty years ago, what is it now, in view of the tremendous annual output of more or less original material? Thirty years ago Dr David Sharp remarked that insects were the most numerous in species and individuals of all land animals, and estimated the number of known species at about 250,000 According to Dr Imms, 450,000 species have now been described

Just about a century has elapsed since W Kirby and W Spence completed—in four volumes—the first edition of a work which was destined to enjoy a great vogue for many years The seventh edition appeared in 1856 as a single volume This work, written in the epistolatory style, was distinctly of the Nature-study order, and was deservedly popular for its store of information concerning the habits of all manner of insects

In 1885 W F Kirby published an "Elementary Text-book of Entomology" dealing with the subject from an entirely different point of view, and doing what was possible, in the space of 240 pages, and with the aid of some excellent plates, to enable the budding entomologist to find his way among the orders and families of insects at that time recognised The second edition appeared in 1892 Then, at the close of the century, came two remarkable works The first portion of Dr David Sharp's treatise on insects in the "Cambridge Natural History" appeared in 1895, and the concluding part in 1899 Meanwhile, in 1898, Dr A S Packard published in America his "Text-book of Entomology"

Dr Packard's work was entirely morphological, and appealed—and still appeals—to the advanced student of comparative anatomy Dr Sharp's treatise was, we believe, the first serious attempt to deal with the subject from all aspects, and, so far as was possible in the space at his disposal, he succeeded triumphantly It is surprising how often workers in the most varied fields find in his volumes precisely the kind of information they require

But Dr Sharp cared not at all for applied entomology The threatened extermination of a rare insect excited his indignation, but the too great abundance of a common species left him cold His sympathy was distinctly on the side of the insects

Now, during the present century, the number of workers in the economic field has vastly increased It is even true to say that a large proportion of our recent advance in entomological knowledge is directly due to them What did we know of mosquitoes or of fleas before their proved connexion with malaria and bubonic plague? Consider the condition of our acquaintance with Hymenopterous parasites before their importance in the control of crop pests was recognised Dr Imms dedicates his book to teachers, advanced students, and those engaged in research, and we feel sure that in the last category he had specially in mind that body of economic entomologists of which he is himself a distinguished member If we add the fact that in a subject attracting so many workers, books a quarter of a century old are necessarily in many respects out-of-date, we see that a new venture was urgently called for, could any one be found sufficiently equipped and sufficiently daring to undertake it

By what criteria must Dr Imms' work be judged? Originality, except in the general scheme of presentation, would be a positive blemish The essential points are that the selection of matter, necessarily very rigorous, should be well balanced and clearly presented, that the latest—not always the latest propounded, but the latest approved—conclusions should be incorporated, and that the student should be put on the track of further information on the point which especially interests him

On the whole, the book before us stands these tests extremely well The bibliographies at the end of each section are most valuable, and the chances are that a "research worker," to use Dr Imms' term, consulting the work on any particular point, will find a concise and trustworthy statement of what is known, and an indication of the sources whence more detailed information may be obtained

We note that Dr Imms does not cater for the medical entomologist, who, he doubtless considers, is well provided with his own special entomological text-books We may instance the short chapter on fleas, which includes no figures of internal structure, and presents a scheme of classification not too recent and referring only to British species

We congratulate Dr Imms on the production of a book which will be valuable to a large number of students and indispensable to not a few

C W

Industrial Research in Cotton

Shirley Institute Memoirs Vol 3, 1924 Pp vi + 362 + iv (Manchester British Cotton Industry Research Association, 1924) n p

THE volume under notice includes twenty-seven original papers in cotton research and an excellent summary of the literature on the action of light on dyes applied to cotton fabrics

Our knowledge of the botany of the cotton plant is already very extensive, and it is of more than passing interest to find in these pages a further advance in the study of the cytology of a plant so long cultivated A count of the chromosome numbers in many varieties of Old and New World cottons has shown that the numbers fall into two groups of 26 and 13 chromosomes, the former comprising the cottons of the New World and Egypt, and the latter those of Asia Unsuccessful attempts to cross American or Egyptian with Indian cottons have often been made, and a possible explanation of the difficulty is thus established

The effects on cotton of the mechanical action of several processes through which it passes in the spinning mill have been thoroughly investigated, and although tendencies in modern industrial practice are in the main justified, the precise information obtained is invaluable The necessity for the control of the atmospheric conditions in testing and in many technical processes is strikingly demonstrated by investigations on the influence of humidity and temperature on the elastic properties of cotton hairs and the absorption of moisture

by raw and soda-boiled cottons. Recent botanical views on the micellar structure of cotton have been strengthened by further and more trustworthy information on moisture hysteresis in cotton, which extends to 1.8 per cent and not to zero relative humidity as was formerly found. Using the Anderson capillary formula, the calculated diameter of the smallest pores (or the smallest distance between the micelles) is of the order of 13×10^{-8} cm.

Micro-analytical methods for the examination of small quantities of waxes are described and the main constituents of the waxes extracted from some American and Egyptian cottons are very similar. The phosphorus and nitrogen contents are consistently greater in Egyptian than American cottons, and in spite of environmental variations the phosphorus content can be used to distinguish between them. It is not possible to say how these results can be utilised in the improvement of the physical properties of cottons, but there are hopeful indications that their application may provide the grower with a means for controlling the quality of the crop. The cotton breeder is badly in need of information in a utilisable form on manufacturing quality, and those who dream of a cotton industry including the grower as well as the spinner may yet see their dreams realised.

A study of the swelling of cotton cellulose in potassium hydroxide solutions, following an investigation into the action of solutions of sodium hydroxide (the reagent used commercially in mercerising), has produced interesting results of a purely scientific nature. The increase in diameter of the cotton hair is less than half that attained in sodium hydroxide solutions, and maximum swelling obtains in the solution of maximum electrical conductivity. It is tentatively suggested that the action of the metallic ion on the swelling of cotton cellulose is consistent with the ionic theory of the swelling of colloids.

On glancing through these twenty-eight researches, one is struck by the number of positive results obtained. The keen practical man should welcome this precise information even though its immediate commercial application may be subject to modification by industrial limitations. Those only interested in the commercial usefulness of the knowledge, who have experienced difficulty in reading the earlier volumes in this series, will have no cause for complaint on this ground. Each paper in this volume is preceded by a short abstract in which the possible industrial applications of the results are written in terms which should be easily understood. Those who have not access to these memoirs, which are not purchasable, will find all these researches published in the Journal of the Textile Institute.

F. P. S.

French Science and Philosophy

Histoire de la nation française. Par Gabriel Hanotaux. Tome 15: *Histoire des sciences en France.* Deuxième volume: *Histoire des sciences biologiques,* par Prof. Maurice Caullery; *Histoire de la philosophie,* par René Lote. Pp. 619 + 12 planches. (Paris: Plon-Nourrit et Cie, 1924.) 50 francs.

Histoire de la nation française. Par Gabriel Hanotaux. Tome 14: *Histoire des sciences en France.* Premier volume: *Introduction générale,* par Émile Picard; *Mathématiques, mécanique, astronomie, physique et chimie,* par Henri Andoyer, Prof. Pierre Humbert, Prof. Charles Fabry, Prof. Albert Colson. Pp. xx + 619 + 12 planches. (Paris: Plon-Nourrit et Cie, 1924.) 50 francs.

THE fifteenth volume of M. Hanotaux' "Histoire de la nation française" is devoted partly to a history of the biological sciences by M. Maurice Caullery, partly to the history of philosophy by M. René Lote. It is a great book in both senses of the term. Each author is extremely well qualified for his task and each has taken great pains in its performance. The proportion of space allotted to science speaks well for the understanding of the general editor, for there is another volume on physical and mathematical sciences, and M. Caullery is careful to lay down at once the right principle for dealing with science or philosophy in such a national work as this. "One cannot write a 'national history' of any science. The history of all the sciences is essentially international. . . . What can be done, and has been attempted here, is to take a particular country as a centre of observation and trace the connexions of the scientific movement there with the general march of thought."

France has a distinguished place in both parts of this volume. Cuvier, Lamarck, Claude Bernard, and Pasteur are a series which will bear comparison with the biologists of any other nationality, and in general philosophy the quality of French thought is well brought out by M. Lote when he speaks of the equilibrium of the French spirit—"raisonnable sans froideur, imaginatif sans fantasmagorie."

The work has been very well done, especially the letterpress, which would command a still larger sale if produced in two small volumes. The illustrations, which are abundant, will arouse more mixed feelings. They are mostly drawings—not executed with the highest French finish—of portraits, tombs, houses, connected with names in the text. The present reviewer finds the black and white drawings not unsatisfactory, but would be happier without the coloured plates.

The fourteenth volume, containing the history of mathematics, physics, and chemistry, came to hand

after the above was written, but it fully bears out the judgment we have expressed and is in some ways better than the fifteenth. M. Emile Picard writes a general introduction describing the characteristics of the French contribution to science and advocating some teaching of the history of science as part of the lycee course. On both subjects he is enlightening and impressive. The general quality of French scientific and philosophic thinking is admirably illustrated by the section on the history of mathematics by MM. Andoyer and Humbert. Vieta, Descartes, Fermat, Bernoulli's, Lagrange, Laplace, Cauchy; it is a magnificent series with which no other nation can compete. If science consists in "mathematising" knowledge, the French have done most in the modern world to advance it, and it is they and not the Germans who come nearest to the rôle of the Greeks. But these French volumes are conceived and executed in as great a spirit of impartiality as is consistent with the general idea of a national history; no great name is omitted, whether it be British, Italian, or even German, though the portraits and other illustrations are almost entirely French.

It is an eloquent testimony to the intellectual elevation of our neighbours that so large a share of a general history of the country should be given to science and philosophy and that the work should be done so well. There is certainly no parallel in any English history, and the two volumes together form perhaps the best extant sketch of the history of science, complemented by M. Lote's section which treats philosophy from the scientific view-point. This also is a feature more common among the French than with us. We heartily congratulate both them and M. Hanotaux on a valuable contribution to scientific synthesis. F. S. M.

Electrodynamics and Radiation

Scientific Papers, mainly on Electrodynamics and Natural Radiation: including the Substance of an Adams Prize Essay in the University of Cambridge. By the late Prof. Samuel Bruce McLaren. Pp. vii + 112. (Cambridge: At the University Press, 1925.) 8*s.* 6*d.* net.

THIS small volume of the papers written by the late Prof. McLaren before he met an untimely fate in the War, and now collected together by some of his friends, will undoubtedly be received with somewhat mixed feelings. The pleasure that we experience in reading and re-reading his delightful analyses of questions which have been the subject of such ardent discussions and are still far from settled, can scarcely be separated from the thoughts of the great loss which science suffered by his death.

The papers themselves are preceded by a short biography of Prof. McLaren, written by Prof. Hugh Walker, which gives an insight into the very human side of McLaren's personality. Then follow the papers on radiation and gravitation drawn up by Dr. J. W. Nicholson. Here we find the classical argument, developed, however, with exceptional analytical power and considerable elegance, against equi-partition and Newtonian mechanics, the conclusion being, as usual, that if we regard the normal oscillatory co-ordinates as being all statistically equivalent, then Newtonian mechanics involves equi-partition. It would, of course, be surprising if the result were otherwise, but the fault is not necessarily with the mechanics; the independent probability argument is capable of bearing at least some of it.

In the later parts of these papers McLaren branches off into highly speculative proposals. Taking the ether—with the electromagnetic equations to define its activity—and assuming that matter in its smallest element (electron) is merely a small spherical sink in the ether, much as a perfect conductor would in fact be, he develops a formal electromagnetic scheme which includes the usual hydrodynamical attractions between sinks as a possible gravitational force. Any such theory is, of course, open to the usual objection that it either assumes too much or results in too much, but it is here developed by McLaren with an attractiveness which compels attention.

In the second set of papers, edited by Prof. Hasse, these ideas are pushed further to include a theory of magnetism. Here the magneton is introduced as a ring sink in the ether—a perfect conducting circuit with a current in it—and calculations of the associated energy and momentum are made and compared with fundamental data. The revolving electron theory of the magneton is rejected as being incapable of explaining paramagnetism on the lines developed by Langevin, the idea being that since the mechanical force exerted on an electron by a magnetic field is at right angles to the direction of motion of the electron, it can never do the work which is required for the orientation of the orbit. There appears to be a slight confusion of thought in this criticism. When a circuit carrying a current moves in a magnetic field, the magnetic forces acting on the contained electrons have a double effect. The components at each point perpendicular to the main direction of the current flow balance the mechanical reaction forces acting on the element there, and the other components balance the electrical or other forces driving or retarding the current. The energies associated with these two actions are in the usual circumstances, equal in amount but opposite in sign, so that the total is zero, and the only

effective result of the action of the magnetic field is a redistribution of the energy as between the mechanical and internal types

In the last paper, not previously published, and now edited by Prof Havelock, McLaren discusses the propagation of a disturbance in a dispersive medium by the Fourier method Here he proves that the mathematical difficulties, which at first appear to be inherently involved in the method, do not in fact present themselves, and that results are obtained which are fully consistent, so far as it is possible to follow them, with the physical ideas of propagation by waves and wave groups

This short review will perhaps give some idea of the scope of McLaren's work, which was all accomplished in the short space of three or four years The book into which it is now all collected will serve as a worthy memorial—it is produced by the Cambridge Press in their usual excellent style—to a fallen colleague, and it can be recommended to every one interested in the subjects with which it deals They will find in it an interesting and still to great extent novel discussion of matters in which alternative points of view are still more than welcome G H L

Our Bookshelf

Pygmies and Bushmen of the Kalahari an Account of the Hunting Tribes inhabiting the great arid Plateau of the Kalahari Desert, their precarious Manner of Living, their Habits, Customs and Beliefs, with some reference to Bushmen Art, both early and of recent date, and to the neighbouring African Tribes By S S Dornan Pp 318 + 16 plates (London Seeley, Service and Co, Ltd, 1925) 21*s* net

The lower the savages, the more difficult it is to make observations among them—to endure the adverse climate or conditions of their habitat, to follow their shifting, unsettled mode of life, to overcome their diffidence Our literature about the pygmy race and the so-called primitive food-gatherers is as scarce as it is important for anthropology The recent additions by trained scientific field-workers—the books of Prof and Mrs Seligman on the Veddahs, of Dr Radcliffe-Brown on the Andamanese, of the Rev W Koppers on the Firelanders—have aroused great interest and already influenced anthropological argument About the Bushmen we know, in spite of some good older accounts, only too little and the present volume is welcome, written as it is carefully, in a clear attractive style, and by one who can claim that "for the opinions expressed in the book the author alone is responsible" It represents mainly the writer's own experiences with the Bushmen and Bechuanas

The bulk of the volume and its most valuable part consists of Chaps v-xxii, on the Bushmen of the Kalahari The descriptive pages are good, especially when they refer to tangible objects—clothing, household goods, implements, weapons and such like, or the typical pursuits—the chase, warfare, trekking and fishing, which, surprising as it sounds, exists in the arid desert of the Kalahari The sociology of these nomadic savages is given but in a cursory manner, as is natural from an amateur ethnographer Even in a chapter with the promising title, "Organisation of Family and Clan," there are, for six descriptive pages on physical appearance, only one page and a half on sociology—and this very slightly treated Some interesting information about the tests in hunting skill and endurance necessary for marriage are given in Chap xiii ("Family life—Marriage, Children, etc"), but the remarks about sexual relations, family life and kinship ties do not go beyond generalities and will be of little use for the comparative sociologist

The most interesting passages of the book are detailed statements of personal experiences of the writer, as they throw some light on the mentality of the natives and on their conduct in ordinary life What Mr Dornan has to say about "Food and Feeding" (Chap xii), about personal relations, about their beliefs and folklore (Chaps xv-xix) is often quite good The chapter on "Knowledge of the Veld and its Lore" shows us the native as a good observer, capable of empirical conclusions and logical argument It should be helpful in dispelling the myth of "savage prelogical mentality"

B M

In Southern Seas Wanderings of a Naturalist By Dr W Ramsay Smith Pp xviii + 297 + 16 plates (London John Murray, 1924) 16*s* net

In this attractive little book a naturalist at ease and in his holiday mood gives us his impressions and personal opinions on several subjects, which he has treated at other times professionally and of which he takes now a bird's-eye view during a recreation trip through New Caledonia, the New Hebrides and Northern Australia The flippancy of style, which seems to be considered a matter of duty in such books, does not interfere substantially with the serious purpose of the book, directed mainly to the study of native races The traveller in the South Seas is naturally led to melancholy musings about the appalling extent of depopulation, the decay of native culture and custom—and he is made to reflect upon the cause of it all "The total effect of all well-intentioned or ill-meaning interference with long-established customs and observances, which were evolved with the race itself and were necessary for its existence and well-being, has too often been to break up the social fabric and destroy physical vigour, it has meant degeneracy or death or both" Dr Ramsay Smith asks the question which must have occurred time and again to every anthropological field-worker and to any thinking and sympathetic white man in contact with natives "Why should it be considered essential to interfere with such customs?" Above all, it might be added, why should we try to destroy all which the natives hold sacred and important, their beliefs, rites, morals, and that while our own religion, which we try to force on them, becomes but its own travesty once it has been grafted upon stone-age mentality "There is no guarantee that the oil or even the Lord's anointed will not turn rancid in some of these places," says the author, and indeed some reflection might have warned us that they are bound to, experience teaches always the same lesson—that they turn

rancid and poisonous, and that in spite of the best intentions

The five chapters on Australian aborigines are instructive, especially where the writer deals with problems of race and physical anthropology It is a pity that no references to other authorities are given, while the information is obviously not all based on personal field-work About the Melanesians there are certain extraordinary statements, such as that "the savage lord of creation does little or no work except to make his wife or wives work" (p 52) Those of us who know the Melanesian at first hand will feel astonished how any one who has visited the islands even on a flying trip could have carried away such an impression

B M

Nauka Polska jej Potrzeby, Organizacja i Rozwoj Tom 5 Pp vi+553 (Warszawa Im Mianowskiego, 1925)

La science polonaise ses besoins, son organisation et ses progrès Resume français des articles parus dans le volume 5 Pp 36 (Varsovie J Mianowski, 1925)

FROM the French resume of the articles in the larger work in Polish we can learn in outline the needs, organisation, and progress of science in Poland This is the fifth annual volume which has been issued by the Caisse J Mianowski, an institute for the encouragement of scientific work Earlier volumes have dealt with the more urgent scientific needs of Poland, proposals for the allocation of funds, and a report of a congress on scientific organisation Some of the more pressing problems concern agriculture, health, education, sociology, and geological survey There are six universities—Warsaw, Cracow, Leopol, Lublin, Wilno, and Poznan, and local scientific societies at Plock, Thorn, Przemysl, and Sandomiez Conferences have been held on physiography, on museums, on education There are some foundations, the Academies at Wilno and Zamosc and the astronomical observatories at Vilno, Poznan, Cracow, and Warsaw, and a monument to Copernicus at Warsaw Information has been collected as to the organisation of science in other countries—in France, Italy, Denmark, Czecho-slovakia, and Finland M J Wojciechowski contributes an article on "The co-operation of the state and of industry in scientific researches in England," with references to the articles by J W Williamson and Dr Kenneth Lee in NATURE for November 15 and December 6, 1924 There is an evident willingness to co-operate with work abroad Relations have been cultivated with France, Italy, Belgium, England, the United States, Switzerland, and Czecho-Slovakia, Poland has been represented at some forty international conferences Polish savants—about two hundred—have been encouraged to travel Scholarships are offered to foreign students Contact has been made with the League of Nations Committee on Intellectual Co-operation

It appears that, although with restricted finance, an endeavour is being made to prepare the conditions for a scientific advance For this reason it may be increasingly important to watch the future volumes of this annual The French abstract is already a useful interpreter Perhaps in the future English and German abstracts could also be offered

H R

The Mineralogy of Scotland By the late Dr M Forster Heddle Edited by J G Goodchild Reprinted under authority of Alex Thoms by the Council of University College, Dundee, assisted by D E I Innes Vol 1 Pp lviii+148+51 plates+4 maps Vol 2 Pp viii+250+plates 52-103+7 maps (Dundee Frank Russell, 1923–1924) 15*s*

BY the publication of these two handsome volumes at so moderate a price, Mr Alexander Thoms and the Council of University College, Dundee, deserve the thanks of all interested in the mineralogy of Scotland Heddle's well-known work has, since its appearance in 1901, been an indispensable book of reference for mineralogists and petrographers, and it is satisfactory that so valuable a compilation has not been allowed to suffer the common fate of a mineral index and go permanently out of print

It is unfortunate, however, that the opportunity has not been taken of removing some of the defects for which the original edition was criticised The book possesses no adequate index, the first requisite in a work of this character, and in consequence the labour of tracing the descriptions of the minerals and their occurrences throughout the text is as long and irritating as it should have been unnecessary The complete disregard of recent published work is also to be regretted Thus, the interesting contributions made to the mineralogy of Scotland by the officers of H M Geological Survey working in Mull are not mentioned, and as a result, the accounts of the mineral occurrences in that island are incomplete and sometimes erroneous

Despite these blemishes, the book remains a lasting memorial of the enthusiasm and ability of the late Prof Heddle It is well printed and produced, and the illustrations are of excellent quality, but it is necessary to warn the reader that not a few of the drawings are examples of artistic crystallographic draughtsmanship rather than actual representations of the crystallography of Scottish minerals

Substation Operation By Prof Edwin Kurtz Pp xiii+261 (New York McGraw-Hill Book Co, Inc, London McGraw-Hill Publishing Co, Ltd, 1924) 12*s* 6*d* net

THIS book is intended to help the workman to understand the principles of substation operation It is a good attempt at giving somewhat advanced technical knowledge in such a way that it can be readily assimilated Very little theory is given, and much of the information has been compiled from official American sources We were interested to read of the care that is taken to protect the operator from shock and burns Not only has he to wear rubber gloves, but he has to wear leather gauntlets over them He has also to blow in the gloves to see whether there are any holes in them In addition he has to put on a leather coat, which must be kept scrupulously clean, and when working with high tension switches he must stand on a stool thoroughly insulated from earth and so constructed that it cannot possibly tip over

Full instructions are given to revive a man when he has had a shock The patient is then to be given some stimulant, "such as one teaspoonful of aromatic spirits of ammonia in a small glass of water, or a drink of

hot ginger, tea or coffee" We are told not to use water to put out a fire at a substation before the station has been made completely "dead" The reason given for this is that the operator would receive a shock if he directed a jet of water on to a "live part" This may be true for very high voltages, but it is not true at low voltages This book will interest station engineers in Great Britain

Physiologische Pflanzenanatomie Von Prof Dr G Haberlandt Sechste, neubearbeitete Auflage Pp xvii+671 (Leipzig Wilhelm Engelmann, 1924) 22 gold marks

THIS work, originally published in 1884, is best known to English students from Prof Drummond's translation of the fourth German edition A fifth edition appeared, during the War, in 1917 The latest edition has been brought more up-to-date, especially by additions to the "notes" at the end of each chapter, the most useful feature being the references to recent German research Some of the rather dogmatic statements of earlier editions have been modified, and it is acknowledged that modern cytological work has reopened questions, such as those relating to the origin of the chloroplastids and other chromatophores, which have previously been regarded as answered By deletion of some less important passages the size of the book has been very little increased, though room has been found for brief accounts of such new discoveries as those of Merl and Czaja on the mechanism of the Utricularia bladders Possibly owing to the lack of access to recent literature, English and American work appears to have been almost entirely ignored Thus the account of mycorrhiza is very incomplete Prof Haberlandt realises that the subject will soon require a more basic revision than can be given without re-writing the whole book, but declares it is not possible for him to undertake this

Fuel Solid, Liquid and Gaseous By Prof J S S Brame Third edition Pp xv+388 (London E Arnold and Co, 1924) 18*s* net

PROF BRAME points out that the second edition of his book was published in 1917, when no large amount of revision was possible, since the issue of the first edition there has been very considerable extension of our knowledge of fuels for internal combustion engines, of the use of powdered coal as fuel, of the ignition points of fuels of all classes, on the velocity of combustion of gaseous mixtures, and on problems of low temperature carbonisation All these subjects have been revised, and the chapters on liquid fuels for internal combustion engines have been re-written Additional material on the composition and the coking properties of coal has also been included The author has made full use of the publications of the Fuel Research Board, and has evidently found them of great value

Metallurgy an Elementary Text-Book By E L Rhead New and revised edition Pp xii+403 (London Longmans, Green and Co, 1924) 7*s* 6*d*

MR RHEAD's little book on metallurgy was first published thirty years ago, and has been through many editions The copy before us is a new and revised edition published late last year Considerable additions have been made throughout the book especially in the metallurgy of iron and steel, copper silver, gold, and nickel Certain processes which have become obsolete or the importance of which has diminished have either been deleted or condensed into smaller compass The author, however, has wisely retained certain other processes which, although obsolete or much modified, make clear the principles underlying their modern successors Elementary metallography has been introduced, and we think he has done wisely in taking this step There is no better method of emphasising that all metals and alloys at whatever stage of their manufacture, provided they are solid, have a definite structure H C H C

The Marketing of Metals and Minerals A Series of Articles by Specialists Edited by Josiah Edward Spurr and Felix Edgar Wormser Pp xii+674 (New York McGraw-Hill Book Co, Inc, London McGraw-Hill Publishing Co, Ltd, 1925) 30*s* net

THIS work consists of a series of articles, each written by a specialist, describing the methods of commercial dealing in the metals, ores and non-metallic minerals produced by the labours of the metallurgist and the miner The economic side of the great mineral industries has been generally neglected in literature, and the present work will be welcomed by a large circle of readers Unfortunately for us, it refers almost exclusively to American conditions, and whilst therefore of very great value to any one connected with the mineral industry in the United States, its usefulness in Great Britain will be limited to the relatively few people who deal with the United States in mineral products A companion volume dealing with British conditions and methods would be of very great value, especially at the present moment

Laboratory Manual of Organic Chemistry By Dr Harry L Fisher Second edition Pp xii+338 (New York J Wiley and Sons, Inc, London Chapman and Hall, Ltd, 1924) 11*s* 6*d* net

DR FISHER has introduced some improvements and additional experiments into the second edition of his excellent book The principal feature is the thoroughly practical character of the information, and the innumerable hints and details given in the descriptions of preparations and experiments will be found of the greatest value to students and demonstrators References to important new work are frequently given The section on elementary analysis is very detailed, and is perhaps the best account in existence

A Class-Book of Chemistry By G C Donington Part 5 *Organic Chemistry* By Prof T M Lowry and Dr P C Austin Pp vi+531-706 (London Macmillan and Co, Ltd, 1925) 3*s*

THIS volume is a continuation of Donington's well-known class-book, and a further volume on physical chemistry is promised The treatment is clear and accurate, and several good experiments are included The book is suitable for medical and pharmaceutical students, and provides generally a useful introduction to organic chemistry Recent work (*e g* on the structure of sugars and starch) is included

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE *No notice is taken of anonymous communications]*

The Fluorescence of Cadmium Vapour

IN the course of the study of band spectra of cadmium and zinc, the question arose whether the vapours of these metals show a fluorescence analogous to the well-known green fluorescence of mercury vapour To decide this problem, the following experiment was made

A quartz bulb was thoroughly evacuated, adsorbed gases being removed by heating it to a high temperature for some days Then a few milligrams of pure cadmium were distilled into the bulb, which was finally sealed off from the pumps The bulb being put into a nichrome-wire furnace, a beam of exciting light from a condensed spark, an arc, or a mercury lamp was projected through the bulb by the aid of a quartz lens

It was found that the fluorescence of cadmium vapour, in the form of a blue-coloured beam of light strictly limited to the path of the exciting beam, makes its appearance and continues over a considerable range of temperature and density of vapour By increasing gradually the temperature of the furnace, first traces of the fluorescence appear about 450° C , with further increase of temperature the intensity of the fluorescence is augmented, and from 600° to about 750° it is very pronounced At a still higher temperature the direct observation of the fluorescence is impeded by the bright glow of the furnace Using a blue glass screen to cut out the red glow of the furnace, however, the fluorescence can be observed up to a temperature of about 950° and more, its intensity being considerably diminished

In order to determine the exciting wave-lengths, various sources of light were employed a condensed spark with the electrodes of cadmium, zinc, aluminium, magnesium, copper, lead, tin, carbon and iron , iron, cadmium and carbon arcs, and also a mercury lamp Almost all these sources gave a more or less intense fluorescence Especially strong fluorescence is produced by the cadmium spark , a very faint one by the magnesium spark , the carbon arc does not produce any fluorescence at all

The excitation of the fluorescence being produced by such different sources of radiation proves the spectral extent of its excitation to be rather broad It lies at any rate below 3000 Å U , as not only a thin sheet of glass, but of uviol as well, put in the path of the exciting beam extinguishes the fluorescence completely

An addition of small quantities of other gases seems also to have a destroying influence upon the fluorescence as proved by the following experiment The bulb, showing a very intense fluorescence, was heated by the Bunsen flame for fourteen hours It was found then that its fluorescent property disappeared totally This is probably due to the diffusion of hydrogen from the flame through the red-hot quartz into the bulb To demonstrate the presence of hydrogen in the bulb, the latter was excited at room temperature by the electrodeless discharge of a Tesla transformer In the spectrum were found some hydrogen lines, which were absent before the heating

In order to examine separately the influence of temperature and density upon the fluorescence, a quartz cylinder provided with a side-tube and having two plane-parallel windows was used The cylinder and the tube could be heated independently in two separate furnaces First of all it was noted that during the rapid evaporation of metal drops condensed on one of the windows, the fluorescence appears particularly intense However, the existence of fluorescence in the bulb, where a permanent distillation does not take place, proves that the evaporation is not an indispensable factor in the appearance of fluorescence

The study of the spectrum of the fluorescence is rather difficult owing to the long exposures (several hours even when a spectrograph of small dispersion was used) which are necessary on account of a comparatively small intensity of light It is also difficult to remove the exciting light scattered by the walls of the bulb

The photographs of the spectrum and the curves got from these by a self-registering microphotometer show, however, that the spectrum has the appearance of a broad continuous band extending approximately from 5000 to 3950 Å U The decrease of intensity, especially towards the more refrangible end of the spectrum, is very gradual The maximum of intensity falls about 4630 Å U This type of spectrum is analogous to the fluorescence spectrum of mercury vapour

Further detailed investigations of the phenomena described are in development

W KAPUSCINSKI

Warsaw,
Physical Institute of University,
June 1925

The Band Spectra associated with Carbon

THERE are now so many as thirteen band groups associated with carbon and its compounds Some of these, such as the violet CN group, have been studied exhaustively, both empirically and upon the basis of the quantum theory I have endeavoured to arrange in progressions and to assign vibrational quantum numbers to all of these groups, where such work has not yet been done, and several interesting new relations have resulted

Lemon (Proc Nat Acad Sci , 11, 41, 1925) has found that the first negative group and the comet-tail bands (low pressure CO bands) appear and disappear under the same experimental conditions and Blackburn (*ibid* , 11, 28, 1925) has made a quantum analysis of the former group Simultaneously, Baldet (*Comptes rendus*, 180, 271, 1925) published measurements of the four heads of each of the 30 bands of the comet-tail group Using the data for all four heads, I find that the first head is given by the equation

$$\nu = 20485\ 4 + (1550\ 46n' - 14\ 07n'^2 + 0\ 043n'^3) - (2198\ 6n'' - 15\ 00n''^2)$$

The remaining three heads are then given by substituting for the constant term 20471 6 20359 1, and 20346 1 respectively Using the older data quoted by Jevons (*Phil Mag* , 47, 586, 1924) as well as Blackburn's data, I obtain similarly for the heads of the first negative group

$$\nu = 45655\ 4 + (1704\ 42n' - 29\ 3n'^2 + 0\ 7n'^3) - (2197\ 03n'' - 15\ 17n''^2)$$

The assignment of the final vibrational numbers (n'') is very certain in the case of each of these groups, and it is evident that well within limits of error both groups correspond to the same final state and are therefore due to the same molecule The experimental evidence indicates that the comet-tail bands are due to CO, while, as the name indicates, the first

negative group is probably due to an ionised molecule Hence it is probable that both groups are due to ionised CO

The assignment of values of n' for the comet-tail bands is slightly uncertain that adopted neglecting the λ5281 band given only by Baldet This band is very weak and 3A out of position If included, it must be the 0,0 band of the group, an unlikely but not impossible state of affairs The intensity distribution is such as to favour the initial states ($n'=0$ to 11, while $n''=0$ to 3 only), quite an unusual distribution However, the distribution of intensity among the values of n', as observed by Fowler (M N Roy Astron Soc, 70, 484, 1910) and by Baldet (*loc*, *cit*) is definitely a high temperature distribution, while the quite different distribution observed in a helium mixture by Merton and Johnson (Proc Roy Soc, A, 103, 383 1923), is equally definitely a low temperature distribution

The high pressure CO bands found by Fowler (*loc cit*) form a single n'' progression ($n''=0$ to 5, while $n'=0$, presumably) Within the very large limits of error, this set of final states is the same as the set of initial states of the comet-tail bands Much more accurate data for the high pressure bands are needed in order to settle the question definitely, but the experimental conditions needed for the production of these bands favour the identity, I believe

The third positive group is well worth a detailed remeasurement and quantum analysis, the successive minima observed by Wolter (*Zeit wiss Phot*, 9, 36 1911) doubtless corresponding to the origins of successive bands of a sequence Accurate data (by Wolter) are available now only for the six heads of the first band of each sequence The resulting $f(n'')$ is closely similar to that of the common nitrogen progression, but is definitely not the same

The triplet bands measured by Merton and Johnson (*loc cit*) have the same unusual intensity distribution noted for the comet-tail bands ($n'=0$ to 6, $n''=0$ and 1 only) The single resulting n'' interval ($\Delta\nu=1714$) is practically identical with the corresponding interval for the third positive group but no conclusion can be drawn without known values of other intervals The $f(n')$ for this group is not related to any other

The fourth positive group is very extensive and is noteworthy in corresponding to a very *slow* initial vibration ($\Delta\nu=500$, approx) and a very *rapid* final vibration ($\Delta\nu=3000$, approx) No other new relations between the progressions of the various carbon groups have been found, so that at present no further inferences as to the identity of the emitters can be drawn from this line of evidence

RAYMOND T BIRGE

Department of Physics,
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June 8

Sensitive Jets and Flames

MANY types of sensitive flame have been described from time to time and measurements of the range of pitch and of the pressure at which they are sensitive have been made, but I have not seen any quantitative record of the variation of the length of such a flame or jet In this connexion some experiments made recently by Mr E Tyler and myself with jets of coloured water flowing into still water seem to be relevant At a certain distance from the nozzle from which it is issuing the stream suddenly breaks down into general turbulence Measurements of the continuous length of the jet, L, under different heads of pressure were made, and hence a curve of velocity of efflux, V_0, against L obtained Two of these are shown in Fig 1, they have the form of rectangular hyperbolæ, a similar curve was obtained with a jet of air mixed with smoke

The shape of these curves can be accounted for on similarity principles The point at which the jet breaks up is taken to be that at which the Reynolds' criterion VD/ν (D = diameter of jet and V = mean velocity at this point, ν = kinematic viscosity) has reached that value at which the motion becomes turbulent If the initial velocity at the nozzle be increased, the critical velocity, V, will be reached at a point nearer the nozzle L will therefore become smaller as V_0 is increased The effect of altering D_0 or ν may likewise be predicted Introducing L into the " criterion in the form of a function of D_0/L,

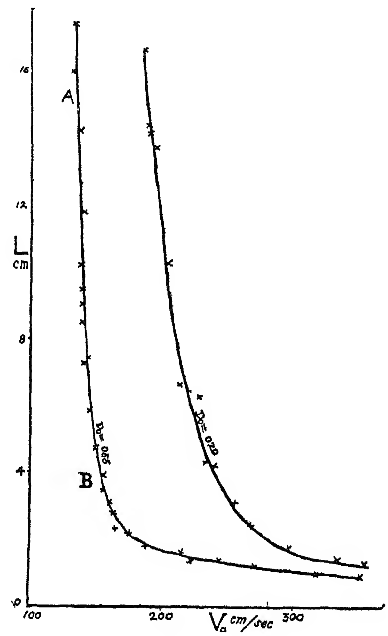

FIG 1

D_0 being the diameter of the nozzle, one obtains $V_0 = K\frac{\nu}{D_0} f\left(\frac{D_0}{L}\right)$ Expanding $f\left(\frac{D_0}{L}\right)$ as a linear function and retaining two terms only of the expansion, since D_0 is small compared with L in sensitive jets, we get $V_0 = K_1\frac{\nu}{D_0} + K_2\frac{\nu}{L}$ that is, LV_0 is a constant for a given nozzle and gas

Further Kohlrauch and also Kruger have shown (*Ann der Phys*, 1881 and 1920) that, in a jet issuing from a circular nozzle, vortices are produced periodically with frequency n, given by V/nd = a constant, d being a linear dimension dependent on the bore of the nozzle The jet should respond most readily to tones of this frequency, or sub-multiples thereof, and a high-velocity jet to sounds of high frequency When a jet of gas is ignited, the combustion complicates matters, as the visible part of the jet lengthens at first as the velocity increases, but Rayleigh showed that, over the range for which they are sensitive, such flames behave in most particulars like unignited jets, the progress of which is made visible by smoke Experiment showed that a sudden small increase in the velocity of the gas feeding a sensitive flame brought the turbulent point—visible as a " flare "—nearer to the nozzle

The other common experience with sensitive jets

and flames that they are sensitive only over a small range of gas pressure, and, therefore, of efflux velocity, is shown by the curves and by theory It is a consequence of the hyperbolic relation between L and I_0, that at a certain value of the latter a small increase in velocity due to aerial disturbances causes a large change in length, so that in using a sensitive flame it is necessary to work on the part AB of the curve E G RICHARDSON

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Science and Intellectual Freedom

ON my return from abroad a few days ago, I found your letter of June 30 awaiting me Allow me to express regret that circumstances prevented an earlier reply Perhaps it is not too late for a brief statement of opinion on the controversy raised by the trial of Mr J T Scopes of Tennessee

Two questions of supreme importance have emerged Liberty of scientific research, and the bearing of the doctrine of evolution on religion

It is certainly an astonishing thing that, after the history of human thought during the last two hundred years, the legislatures of States which lay claim to some degree of civilisation should be found restricting science within limits prescribed by special interpretations of Holy Scripture It does not seem to have occurred to these good people that, on such conditions, scientific research becomes impossible Nor do they see that they are seeking to restore that very state of things which delayed the advance of human knowledge for centuries They have still to learn that truth must be sought for its own sake

Again, they are mistaken in thinking that the doctrine of evolution is anti-Christian To my judgment, exactly the opposite is the fact Evolution teaches the unity of all creation it reveals an organic relationship among all living things, making us all akin it enables us to form a conception of the Creator as One who is not remote from us in some transcendent sphere, but is Life of our life and continually at work in the universe These are Christian ideas they may be said to be among the essential ideas of Christianity

As to the early chapters of Genesis their sublime accounts of the beginnings of things lose all their true value if we regard them as scientific statements They are full of meaning if we view them as the expression of fundamental religious principles in the language and imagery of the age to which they belong CHARLES F ARMAGH

THE Tennessee trial has given the readers of NATURE an amusing motley of opinion, but are we not perhaps, treating the rejection by 'Main Street" of the much over-advertised Mr Scopes too seriously and missing the real significance of the occasion ? Is not a lesson of profound social importance behind it all ? We are talking glibly of interference with "freedom of thought' Is there any such thing — even in the ranks of our boasted "science" ? Are not the teachers for the most part, just repeating what they have been told, without exercising any thought ? Is the Pauline injunction *Prove all things, hold fast that which is good,* in any way followed ? If it were, societies would have no difficulty in meeting costs of publication Whatever may be the case in biology, it certainly is not on the physical side We mostly use the "Main Street" method but are at the disadvantage that we have no bible holding our faiths which can be put into the hands of the public Consider our Press, consider our politicians—the Cabinet, even our Public Schools, are not all these located in "Main Street" ?

Scientific method, the method of proving all things, is only known to and used by the few who are real makers of knowledge—science factors The scientific, like all artistic gifts we must recognise to be an "inborn error of metabolism" Our text-books are as dogmatic as is the great book used of "Main Street" This not only has the advantage of great beauty of language but also a concealed authority behind it—Man's innate belief in a superior being—which we cannot command The "Aunt Susans" who teach it do so with a thoroughness and sense of conviction which we can in no way match

Any one who wishes to gain some inkling of its power should study Ruskin's "Modern Painters"—the work of an arch critic gifted with a mind of transcendent power, not an obscurantist The practical achievements of the scientific mind are blinding us to our failure to teach and use scientific method in our ordinary affairs We need be in no hurry to force our speculations into the schools—better not We do need to teach all to respect our method, though, maybe, it is that used only in the best circles We need, on all possible occasions, to make clear, to ourselves and others, the significance of the assertion, to which Sir Bryan Donkin and Sir E Ray Lankester directed timely notice recently made by the late W K Clifford—*It is wrong always everywhere and for any one to believe anything on insufficient evidence*—let alone teach it as truth, as is so often done in our classes We have gradually to repave 'Main Street" with such doctrine our difficulty is that most of us are born to live in it—as it is Yet when Bishops can write as do those of Birmingham and Durham, we need not altogether despair—though these also are probably 'metabolic errors'

HENRY E ARMSTRONG

Changes in the Ultra-violet Absorption of Gelatin

IN some investigations on the ultra-violet absorption of gelatins, we have discovered that the absorption spectrum changes in a characteristic manner according as the gelatin is on either side of the iso-electric point, indicating that the different P_H values are associated with a definite change in the chemical constitution Taking the iso-electric point as 4 7, when the P_H value of a gelatin rises above this, there is a characteristic increase in absorption from about 3500 Å U towards the red end, while with a fall in P_H there is an increase in absorption in the region of *shorter* wave-lengths These very marked changes in ultra-violet absorption would appear to provide a valuable means of investigating minute changes in the constitution of gelatins T THORNE BAKER
L F DAVIDSON

The Oogenesis of Lumbricus

REFERRING to Dr Graham Cannon's letter in NATURE of July 18, I may be permitted to remark that the reason why it is not only inadvisable but even unprofitable to discuss oogenesis in general, on the basis of work done on a single species of one order, is that, unlike the chromosomes, the Golgi bodies and mitochondria are variable in behaviour in different orders and even within a single family This is the most important fact which recent researches on the cytoplasmic inclusions have revealed, and, of course, throws a clear light on the question of the status of these bodies in heredity

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Regions of Tension and Continental Drift[1]

By Dr. J. W. EVANS, F.R.S.

IN many areas the earth's crust has been subjected to compression manifesting itself in folding, cleavage, thrust-faults, and certain types of igneous activity. Such compression may prevail over an extensive region, or may be of a purely local character. In the former case, it is usually attributed to the progressive contraction of the earth's interior, although this has been disputed by some authorities. In the latter, it is merely an incident in the development of more extended structures. The results of compression have long been studied, but comparatively little attention has been given to the occurrence of tension in areas where it has left evidence of its existence in the form of joints, normal or slip-faults, occasionally replaced by monoclinal folds, dykes, and other characteristic igneous phenomena.

The distribution and direction of the jointing, the slip-faulting, and the dykes of western Europe of post-Hercynian date, are all due to tension, producing stretching, fracture, and separation, and together they imply relative movement, or drift, in the rocks with which they are associated.

The most prevalent strike of these fractures in the British Isles and western France is from north-north-west to south-south-east, implying a drift from east-north-east to west-south-west, or *vice versa*. However, in the Devon-Cornwall peninsula there appears to be a general downward slip to the south-west, modified later, it would seem, by a movement towards the north-west. In Skye the faults posterior to the igneous activity seem to show a similar change in the direction of the tension. In the north-west of Connaught, of Ulster, and of Sutherland the faults appear to strike as a rule north-east and south-west, implying the presence of a drift to the north-west, but in western Ulster, and in Mayo, this appears to have been preceded by an earlier tension directed towards the south-west or south-south-west, indicated by the north-west and south-east or west-north-west and east-south-east basic dykes.

Closely connected with the drift of the surface-blocks must be the stretching of the presumably plastic zone beneath. Indeed, it would seem that it is this stretching or slow flow which is the immediate cause of the minor fissuring of the crustal rocks. The blocks which are thus formed are then so disposed relatively to one another as to cover, so far as possible, the extended space. This may happen in two ways.

In the south-western peninsula of England and other localities the fault-fractures had originally considerable hade, usually directed to the region of weakness, and the extension took place by the downward slip of the block on the upper side of each fault.

In Skye and elsewhere the hade of the fissures seems originally to have been practically vertical, but the blocks between the faults were afterwards inclined, so that the beds which were formerly nearly horizontal now dip in a direction opposite to the faults. In this case the covering of the extended area is effected by the tilting of the blocks. It is probable that in such cases the underlying magma has, it is suggested, flowed in the direction of the hade of the faults.

The volcanic activity in the west of Scotland and in the north-east of Ireland commenced, on the evidence of plant-remains, early in the Eocene, and may have continued for a great portion of that period. The faulting which has been described must have been of still later date. It is indeed impossible to fix any limit to the continuance of the tension. How far it was present in Mesozoic times we cannot say with certainty, but it apparently had a beginning in the Permian.

The drift towards the west (south-west or north-west) in western Europe seems to have been widespread, though greater in some regions than in others, but everywhere east-and-west distances appear to have been increased.

We are not in a position to estimate the total amount of this extension. It could only be calculated if we knew the width of each joint, the hade of each fault-plane, the direction and amount of the movement in it, and the thickness of each dyke. It does not, however, seem likely that the total relative change of distance between Central Europe and western Ireland has exceeded, say, 6 to 12 miles (10 or 20 km.) since Triassic times.

The true significance of this drift becomes evident on examination of a depth-chart of the North Atlantic. It is at once seen that the approximately north-west and south-east strike of different forms of fracture that is so prevalent in the British Isles and western France is related to the ocean-deep of which the north-eastern boundary runs roughly south-east and north-west, parallel to the French coast of the Bay of Biscay, out into the open Atlantic; and that the north-east and south-west strike which is found in the north-west is apparently similarly related to the edge of the trough that extends from south-west to north-east beyond the Hebrides. The drifts to the south-west and north-west seem to be towards these abysmal regions of deep water, the crustal blocks being carried forward by the flow of the plastic region beneath. The formation or widening of these deeps cannot have greatly preceded the drift towards them, which seems to have culminated in Tertiary times. From what has been stated, there would seem to be reason to suppose that the development of the oceanic deep on the north-west of the British Isles was of a later date than that on the south-west.

The doctrine of the balance or "isostasy" of different areas of the earth's surface, which now seems to be firmly established, requires that the continents should be composed of lighter materials than the floor of the deep sea. The former consist mainly of granite (including the foliated granite more usually described as granitoid gneiss) and of sedimentary rocks which, though widespread at the surface, form only a comparatively small part of the whole. These are together conveniently referred to as sial. The ocean-beds must, on the other hand, be composed of heavier rocks made up of the silicates of iron, manganese, magnesium, and

[1] From the presidential address delivered to the Geological Society of London at the anniversary meeting on February 20.

calcium—the sima of Suess This conclusion is confirmed by the greater "magnetic permeability" of the ocean-floor compared with the continents, indicating in the former the presence of ferrous oxide [2]

The distinction between sial and sima appears to be the result of a primeval magmatic differentiation of the outer zones of the earth into a lighter acid portion consisting mainly of silica with alumina, the alkalies, and much water and other volatile constituents—that is to say, the typical magma of acid rocks such as granites and rhyolites—and a heavier basic portion corresponding to the magmas of dolerites and basalts, passing doubtless below into that of the still more basic peridotites

There seems to be no doubt that Suess was right in supposing that the sima extends everywhere below the sial of the continents There is, however, considerable difference of opinion as to the thickness of the continental sial Wegener [3] supposes it to be so much as 63 miles (100 km) This is founded largely on Hayford's level of isostatic equilibrium or uniform density, which he placed at a depth of 71 miles (114 km) It was afterwards reduced by Bowie to 60 miles (96 km), which, however, appears to represent the depth of the sial forming the downward extending folds of the Rocky Mountains Doubtless in the Himalayas it would be still greater, but in plains and plateaux the thickness may perhaps range from 9 to 40 miles (15 to 64 km) [4] It would depend on the altitude of the land and on the density of the sial Nor is the depth to which the sial extends necessarily the same as that of the depth of uniform density In the older parts of the continental shields the latter is probably considerably less than the former

The idea that ocean-depths are the result of foundering is wholly opposed to the doctrine of isostasy, for it implies that the rocks which form the floor of the oceans are of the same composition as those of the neighbouring continents

The only alternative is to conclude that the continental masses of sial can, under the action of continuously applied external forces, slowly drift through the sima, and that they have thus moved apart and left the ocean-deeps between them

The magma of the granite of the sial must, on account of the large amount of water and other volatile constituents that it contained, have cooled to a comparatively low temperature, say 600° C , before it crystallised These constituents were, however, eliminated and lost, so that it would thereafter require a much higher temperature to melt or even soften the rock, and the sedimentary constituents of the sial would (as a rule) prove equally refractory

The basic rocks that constitute the sima, especially if they are rich in iron, are on the other hand less affected by the loss of volatile constituents We may therefore expect that, at a temperature corresponding to comparatively moderate depths, they would become to some extent plastic

The principle of isostasy appears in fact to depend on the circumstance that, given sufficient time, by no means very long from the geological point of view, the sima acts as a whole as a fluid in which the sial floats, to use Airy's simile, like a log in water, or in Wegener's words, like ice-floes in the sea, although, it need scarcely be said, the viscosity of the sima (even at a fairly high temperature) is many thousands of times that of water There is therefore nothing surprising in the blocks of sial making their way through the sima, accompanied, it may be, by crystallised sima adhering to their lower surfaces

It is to the major fissures of the earth's crust, which are represented by the ocean-deeps, that we must look for the fundamental cause of igneous activity in regions of tension As the fissure opens, the underlying sima magma will rise, in order to re-establish a condition of isostasy This will be facilitated by the fact that the accompanying release of pressure will render the magma fluid, and at the same time cause it to expand This expansion will be all the greater, on account of the volatile constituents in the magma Its density will of course diminish correspondingly, and it will rise higher in the fissure than it would otherwise have done

In the course of time, however, a large proportion of the volatile constituents will escape, crystallisation commence, and the density increase, so that the column will sink to a certain extent [5]

Some idea of the depth from which the sima of ocean-deeps rises can be gathered from the temperature of igneous magmas Dr H H Thomas, from an examination of the metamorphism of the xenoliths in the Loch Scridain magma-reservoir, arrived at the conclusion that it was initiated at a temperature of nearly 1400° C [6] This figure rests on experiments with dry metals, and must, he thinks, be reduced, if the presence of water under pressure be taken into account Some heat may have been lost while the magma was rising, and during the course of its intrusion , but there may have been a slight accession of temperature from oxidation or radio-activity We may, however, assume for purposes of illustration that the temperature in the original position of the magma was in the neighbourhood of 1400° C

According to the calculations of Prof L H Adams, which appear to rest on a sound basis,[7] this temperature would be ordinarily found at a depth of about 72 miles (115 km) This actual figure is, at best, a conjectural estimate , but it would seem probable that some parts at least of the magma of igneous intrusions must come from a depth that cannot have been very much less It would therefore seem that the formation of these major fissures presents the most probable means by which material from great depths has reached the neighbourhood of the surface, a conclusion which is of some importance in considering the source of the metalliferous ores

Before the opening of a fissure, differentiation at such depths would be impossible, on account of the extreme viscosity of the magma under heavy pressure, but the release of pressure due to the opening of the fissure

[2] A Wegener "The Origin of Continents and Oceans, 1924, pp 32 33
[3] *Ibid* p 37
[4] H S Washington s estimate is from 15 to 20 km (9 to 12½ miles), Journ Washington Acad Sci , vol 14 (1924) p 437

[5] An incidental effect of the formation of rifts would be the lowering of the level of the sea The area of the deeps lying below 15 000 feet (4573 metres) is about a third of that of the whole ocean If, then, a tenth of these came into existence as rifts about the same time in consequence of an average sinking of 7500 feet (2287 metres), the surface of the sea would be lowered by about 250 feet (76 metres) These figures are of course, only intended to show that the effect would not be negligible
[6] Q J G S , vol 78 (1922), pp 250 54, and Island of Mull Mem Geol Surv 1924 p 278
[7] Journ Washington Acad Sci , vol 14 (1924) p 468

would result at once in an increase of fluidity The first differentiation would be, in all probability, a repetition of the primordial process of differentiation into basic and acid magmas already mentioned, for the sima would appear to be capable of yielding another but smaller crop of an aqueous acid magma This would be followed by further differentiation by crystallisation due to cooling as well as to loss of volatile constituents, with the result that ultimately a wide range of igneous rocks would be evolved [8] Before, however, differentiation had advanced very far, a series of lateral intrusions from the major fissures would have commenced The flow of the deep sub-crustal sima towards the fissure would cause a temporary sinking of the adjoining crust, simultaneous with the rise of the magma in the fissure, with the result that, for a portion at least of the length of the column filling the fissure, the pressure of the magma would exceed that of the surrounding rock, so that intrusion would take place

As differentiation proceeded in the intruded magma, the progress of the segregated acid magma would be retarded by local viscidity, caused by the loss of a portion of the volatile constituents and by cooling at the surface of contact with the adjoining rock This would not be the case with the ultra-basic and basic magmas below it (which would form by far the greater portion of the whole), as they contain less volatile constituents, and are less dependent on them for their fluidity The ultra-basic and basic magmas would, therefore, progress more rapidly than the acid magma In so doing they would let down the still fluid portion of the acid magma above them until the latter reached the level of their flow Here it would be protected from loss of volatile constituents, and the temperature of the surrounding rock would by this time have become little less than that of the magma itself The acid would therefore follow the basic magma in the channel of intrusion, a succession which corresponds very closely to the order of intrusion of plutonic magmas in the west of Scotland and at the Lizard [9]

How far this lateral penetration will extend, and what form it will take, depend on the nature and structures of the rocks, and the earth-movements that may supervene A magma may travel a considerable distance horizontally, or with a gentle inclination upwards—without any manifestation, other than the filling of fissures at right angles to the prevailing tension—until it meets with an obstacle, such as deeply-rooted mountain-folding, when it may form a tumefaction in the nature of a laccolith which will become a centre of igneous activity, and give rise to radiating and concentric structures as well as plutonic rock-masses, or it may well out in fissure-eruptions Its progress and manifestations will be due partly to the hydraulic pressure to which it is subjected, and partly to the expansive force of its volatile constituents, and these will be assisted in some cases by faulting, bringing the magma into contact with rocks under less pressure, into which it will penetrate along joint- or fault-planes

Of all these manifestations of igneous activity, it is the occurrence of parallel dykes that is usually the most widely extended, both in space and in time, and affords the most satisfactory evidence of the area throughout which a subterranean magma has spread —so far at least as it is accompanied by a prevalence of tensional conditions above it

[8] That the first stage of the differentiation of igneous rock is into an acid and basic magma is to my mind abundantly proved by Dr W A Richardson and G Sneesby s analysis of the frequency of igneous magmas of different silica percentages This clearly shows two distinct peaks, one acid and the other basic *Min Mag*, vol 19 (1922), pp 303 13

[9] I have long advocated such an explanation of the order of intrusion of plutonic rocks in my lectures at the Imperial College of Science and Technology I may add that the ultra basic magma would move more rapidly than the basic for on account of the excess of the density of the basic magma over that of the adjoining rock, the maximum difference of pressure will occur below it

(To be continued)

The Nutrition of Cattle

THE subject of the feeding of cattle assumes importance from the large part their products play in human dietaries An accurate knowledge of their metabolism and nutritive requirements, apart from its intrinsic scientific interest, may lead both to more economical methods of feeding and at the same time to an improvement in the quality and quantity of the products, meat and milk, obtained from them In this survey a brief account will be given of some recent work on the energy, protein and mineral requirements of these animals, with special reference to the production of milk in dairy cows

The measurement of the energy requirement resolves itself into the problem of estimating the heat given out by the animal, since to maintain the body in equilibrium a similar amount of energy must be taken in in the food The output of heat can be measured directly by placing the animal in a calorimeter, or chamber in which the heat emitted is measured by the amount absorbed by a current of cold water circulating through the chamber, the analysis of the ingoing and outgoing air at the same time will give the consumption of oxygen and output of carbon dioxide during the experimental period The method requires the use of elaborate apparatus, so that in practice the indirect method of determination of the heat output is more frequently employed In this the output of carbon dioxide and consumption of oxygen are determined over a short period, and from these data, together with the value of the respiratory quotient, *i e* the ratio of carbon dioxide produced to oxygen consumed, a value can be found for the heat production which is sufficiently accurate for most purposes The respiratory quotient conveys information as to the types of foodstuffs which are being oxidised in the body, and this information is essential since the heat produced varies according to the type of foodstuff, protein, fat or carbohydrate utilised

The problem of estimating the heat output in the case of cattle has been still further simplified by W W Braman (*J Biol Chem*, 1924, vol 60, p 79) the only data required are the output of carbon dioxide and the amount of food taken In a large number of experiments he has found that the ratio heat/carbon dioxide is highest in starvation and falls steadily with increase in the amount of food eaten, the heat production increasing more slowly than the carbon dioxide formed

The change is due to the fact that in starvation most of the heat produced comes from the oxidation of fat, which has a high calorie value, whereas the food is chiefly carbohydrate with a relatively low calorie value These experiments enable an investigator, by estimating the carbon dioxide production and noting the food consumption, to determine the approximate heat output by applying the formula given by the author or by reading from the graph relating the ratio heat/carbon dioxide to the food consumption, which is approximately a straight line The heat output thus calculated agrees closely with that actually observed in a calorimeter

A more elaborate, but more accurate, indirect method of estimating the heat output of cows has been utilised by J A Fries, W W Braman, and D C Cochrane (U S Dept of Agricult, Bull No 1281, 1924) The method depends on the fact that in an animal which is maintaining its weight, the heat output must equal the energy of the food actually utilised by the body during the experimental period Of the food taken, some is not absorbed and some is excreted in an incompletely oxidised form The digestibility of the food is usually estimated by taking the difference between the amount eaten and the amount excreted in the fæces, but the authors point out that in cattle, bacteria in the intestine play an important part in digestion At the same time, one of the products of their fermentative action is a gas, methane, whilst the process itself is accompanied by an output of heat The methane produced has been estimated in the respiration calorimeter, and the heat of fermentation from the ratio of methane to carbon dioxide in the products of fermentation The results show that whereas the digestible portion of the food appears to be about 66 per cent of that taken by estimation by the usual method, by taking account of the above two factors also, only about 50 per cent of the food consumed is actually absorbed and available for energy and heat production The actual energy of the food was determined directly by the bomb calorimeter, and thus the actual energy available to the body is known Nearly all this energy is available for maintenance, growth (or increase of protein or fat in the body), work, and the production of milk, about 10 per cent being lost in the processes of digestion and in the formation and elimination of the excreta The authors have compared the heat production calculated from the available energy of the food with that actually observed during the same period in the respiration calorimeter and have obtained a very good agreement The result indicates, in their opinion, that this method of "indirect calorimetry is sufficiently accurate for purposes of research in the feeding of farm animals"

Of the energy available to the body in the food, about half is required to maintain the body-weight constant the remainder can be utilised for increase in body weight or for milk production The data show that a larger proportion of the energy available is found as energy in the milk than in any increase of body weight, the process of milk formation appears to be more economical than that of body tissue and fat formation The result suggests that the food materials are available directly for milk formation and do not have to become body tissue first and milk later Of the available energy, 90 per cent or more can, under certain conditions, be utilised in milk production

It is of course essential that the conditions of the experiment should be kept as constant as possible in different experiments One factor which may introduce a disturbing element is the relative amount of time spent by the animal in the standing and lying positions This subject has been considered in more detail by J A Fries and M Kriss (*Amer Journ Physiol*, 1924, vol 71, p 60) They found that allowance must be made for the taking up of heat by the floor on which the animal lies in the respiration calorimeter, this heat being afterwards given up when the animal stands, making the heat output of this period too high The magnitude of this error can be ascertained by estimating the carbon dioxide output and assuming that the ratio heat/carbon dioxide is a constant Making this allowance, it was found that the heat output of a 400 kgm cow increased by about 25 calories per hour on standing The authors recommend that the heat production be calculated to a standard day of twelve hours lying and twelve hours standing, so as to obtain uniformity in the expression of the results obtained by different observers

It is of interest to note that in the later stages of gestation, a cow appears to require about 2 per cent more food for maintenance than a non-pregnant animal of the same weight

The utilisation of protein in milk production has been considered by J A Fries, W W Braman, and M Kriss, and also more recently by E B Forbes and R W Swift (*Journ of Dairy Science*, 1924, vol 7, p 11, and 1925, vol 8, p 15) The two sets of experiments agree fairly well in showing that in well-fed animals the utilisation of protein for milk production is about 40 per cent of that available for this purpose (that is, the digestible protein of the food less that required for maintenance) With decrease in the protein intake, however, the former authors found that a larger proportion of the available protein, up to 85 per cent, became available for milk production, since the nitrogen excretion falls *pari passu* with the drop in nitrogen intake, whilst the nitrogen in the milk remains almost constant With a higher percentage utilisation, however, the amount of milk produced tends to fall off, being increased again with increase in the protein intake The optimum nitrogen intake was an amount of available nitrogen about 10 per cent greater than the nitrogen found in the milk produced The animals maintained their weight, whereas with a larger protein intake the animals gained in weight by the deposition of fat, together with an increased formation of body tissue The fact that with low nitrogen intakes the quantity of milk produced tends to fall off in a cow producing a large amount daily, suggests that the level of optimum intake of nitrogen as regards the nitrogen of the milk is not the optimum level for the production of a large quantity of milk, which contains both fats and carbohydrates as well as protein, and therefore that the animals should be well fed, if the best results as regards milk production are to be obtained

In addition to the proteins, fats and carbohydrates present in milk, account should also be taken of its vitamin and mineral content in estimating its quality Ultimately these factors come from the food, in which

they should therefore be present, but the amounts passed into the milk may be greater than can be absorbed in the food, leading to a depletion of the animal's own stores This appears to occur especially in the case of the calcium of the milk During liberal milk production on winter foodstuffs there may be a definite loss of calcium from the body, on fresh foodstuffs this loss is less or may be absent (E B Forbes, Washington Government Printing Office, 1924) This effect is quite probably to be related to different amounts of vitamin A present in the dry and fresh green foodstuffs, but it seems to be clear that the cow should be encouraged to store as much calcium as possible in her body during her dry periods by the giving of calcium, for example, in the form of bone meal, in addition to an adequate supply of fresh green foodstuffs It is possible also that the addition of sodium phosphate to a dried ration may increase the milk yield after parturition, suggesting that this food may be deficient not only in calcium but also in phosphorus, or that the availability of these elements present in the food is impaired by a deficiency in the fat-soluble vitamin A

The general result of all these investigations is that a dairy cow should be fed on an abundance of fresh green food, containing a supply of protein, etc, which is sufficient to maintain both the quantity of the milk produced at a high level as well as its protein, mineral and vitamin content If this be done, the supply of energy will certainly be adequate also

Current Topics and Events

Scientific aspects of national life were honoured by the attention and interest given to them on two occasions last week by the King and Queen On the afternoon of Wednesday, July 22, their Majesties visited the Royal Society and examined with much interest many of the exhibits arranged for the annual conversazione of the Society held on the evening of the same day They were also present at a lantern lecture by Mr F E Smith, Director of Research at the Admiralty, upon the subject of navigational devices On Thursday, July 23, the King and Queen visited the Royal Observatory, Greenwich, in connexion with the celebration of the 250th anniversary of the foundation of the Observatory They were received in the Octagon Room by Sir Frank Dyson and conducted round the Observatory A number of members of the Board of Visitors and delegates from abroad of the International Astronomical Union had the honour of being presented to their Majesties

A slight anticipation of dates was made in the celebration of the 250th anniversary of the Royal Observatory, Greenwich, on July 23, in view of the presence in England of the large body of foreign astronomers who had come for the meeting of the International Astronomical Union at Cambridge Actually the foundation stone of the Observatory was not laid until August 10 1675, and Flamsteed did not come into residence until July 1676 However, an exact adherence to dates is seldom possible in these commemorations and the circumstances amply justified the anticipation The celebration was honoured by the presence of the King and Queen, this being the second visit of a British sovereign to the Observatory since its foundation, the previous one was by George III Although Charles II showed so much interest in its foundation, there is no record extant of his having actually visited it Their Majesties were conducted round the principal domes by the Astronomer-Royal and later expressed the interest and pleasure that they had derived from the visit It may be well to remind younger readers that our "Sailor King" has been through the complete course of a naval officer, and commanded a destroyer, so that he has a full knowledge of nautical astronomy The prime object of the foundation of the Observatory was to aid navigation this end has been kept in view up to the present as we see in the rating of chronometers, the dropping of time-balls at Greenwich, Deal and elsewhere, and the continued observation of the positions and motions of sun, moon and fundamental stars The evolution of the chronometer could be traced by the visitors, since the three earliest timepieces of Harrison were exhibited Two of them have lately been restored, and were actually going, so that they could be compared with a large number of modern chronometers

The sudden death on July 26, at the age of sixty-five years, of Mr W J Bryan, orator politician and Fundamentalist, has come as a shock to all who followed the course of the trial at Dayton, Tennessee, of Mr J T Scopes, who was convicted of breaking the State law against teaching the truth of evolutionary theory Mr Bryan conducted the prosecution ably, but during his examination by the defence, he made some remarkable statements as to the precise dating of events in the Biblical record The Flood was fixed as probably having taken place in 2348 B C, while the confusion of tongues at the Tower of Babel was assigned to 2230 B C Mr Bryan conceded that the six days of creation must be regarded as periods of time A further admission that the creation might have continued for millions of years may perhaps open the way to some sort of accommodation with geological evidence, it might even admit of an adjustment with the one hundred and thirty thousand years or so which at least seem to be demanded for man's existence on this earth by the evidence of the stone implements of Lower Palæolithic Age—to say nothing of those of earlier date In putting to Mr Bryan the evidence for the existence of civilisation in China before the Bible creation 6000 years ago, counsel was perhaps on somewhat uncertain ground, although the Shu-king begins with a record of the days of Yaou (2355 B C) and Shun, who brought to a close the second patriarchal dynasty of China, founded by Foh-hi in the year 2943 B C On the other hand, Mr Bryan's fellow-countryman, Mr Pumpelly, estimated that the beginnings of the neolithic stratum which he excavated at Anau in Turkestan dated back somewhat before 8000 B C

Although archæologists are inclined to regard Mr Pumpelly's dating at Anau as too early, and display the same hesitation in accepting the very high dating of M de Morgan for the early civilisation he found at Susa, the results of recent excavations in Mesopotamia are of considerable interest in relation to the question of early datings The work both at Kish and at Ur and the neighbouring site of Tel el-Obeid in the last two or three years has considerably extended the period of antiquity of which the dating may be considered to have been fixed with a reasonable degree of accuracy At Kish, for example, an inscription of Lugul-ud, king of Kish prior to 3100 B C, has been discovered, and below the floor of the building in which it was found lie 15 feet of debris, which on a conservative estimate would place the early occupation so far back as 4500 to 5000 B C At Tel el-Obeid a marble socket of a gate has been found which bears the inscription of a king of the first dynasty at Ur According to Babylonian tradition, this dynasty was the third to rule after the Flood This discovery vindicates the existence of the dynasty, which had hitherto been regarded as mythical like its two predecessors, and if the dead reckoning estimate of its beginning in 4600 B C is too high, 4000 B C or 3900 would be a not unreasonable date In Egypt, as is well known, astronomical data are available, though gaps in the records give some uncertainty to early dates On the lowest estimate, however, the accession of Menes the first king of the First Dynasty, is assigned to 3400 B C, while the calendar was introduced in 4241 B C

In a speech delivered at a luncheon of the British Optical Instrument Manufacturers' Association on Thursday, July 23, Mr F Twyman, the president, gave an instructive and encouraging review of the present technical condition of the optical instrument industry of Great Britain It is well known that the industry has suffered enormously during the financial and commercial decline of the past few years It is not so well known, however that these years have been for the industry a period of experiment and development, of prolonged and successful effort towards improving its products, inventing and putting new products on the market, and increasing its equipment for producing The experimental and research work carried out continuously by members of the industry has resulted not only in an increase in the range of products, but also in developments of real scientific importance From many examples quoted, it would seem probable that most of the research of the world, in certain fields of prime importance in modern physics, is being done with British-made instruments The growing use of optical instruments for the control of industrial processes, and for maintaining a high and uniform standard of quality in the productions of important industries, has undoubtedly been encouraged by the fact that these industries have been able to obtain from British optical firms suitable instruments, often very complex and designed with great inventive ability to achieve the particular end desired The technical advances and achievements in regard to the design and production of optical instruments, enumerated by Mr Twyman, give evidence that the industry is active in invention and development and in the application of the results of scientific research conducted by it or on its behalf The result is seen in its ever-improving position in the race for technical supremacy

A meeting, called by the Optical Society to consider the desirability of arranging an Optical Convention in 1926, was held at the Royal Society of Arts on Tuesday, July 21 Sir Herbert Jackson presided, and there were present representatives of all branches of the optical and scientific instrument industry, together with representatives of cognate scientific and technical societies, and others interested in the theory and practice of optical science and in the use of optical instruments The chairman intimated that the object of the proposed Convention was to bring before the notice of the scientific and general public the many and important developments which had taken place in recent years in British optical apparatus and instruments, and to show that the products of the optical glass industry and the optical instrument industry of Great Britain were well able to compete with those of foreign competitors It was for the manufacturers to decide whether the time was opportune for holding such a convention Several of those present spoke in favour of the proposal and it was resolved that a British Optical Convention be held at the Imperial College of Science and Technology, South Kensington, in July 1926, and that a guarantee fund of 2000*l* be raised, if possible, before October 1, 1925 It was announced that the Council of the Optical Society had already agreed to contribute a sum of 200*l* towards such a fund Thereafter, a general committee consisting of those present was formed, and an executive committee nominated, with powers to make the necessary arrangements Detailed proposals will be published with regard to the scope and scheme of the Convention as soon as the executive committee has considered the various matters involved

The second of the annual conversaziones of the Royal Society was held in the Society's rooms on July 22 The majority of the exhibits arranged for the occasion were also shown at the first conversazione (Nature, May 23, p 819) Among the fresh exhibits were six models of early locomotive engines, pieces of apparatus used by Sir William and Sir John Herschel and a replica of an early Egyptian astronomical instrument This instrument, the "Merkhet" of the Egyptians, and the "ὡρολογιον" of the Greeks, was used to lay out a meridian line and to note the meridian passage of stars for determining the time in connexion with temple ceremonies The original in Berlin dates from about 700 B C, but the instrument was in use very much earlier These exhibits were shown by the Science Museum Mr W Bateson and Mr R J Chittenden (John Innes Horticultural Institution) showed examples of root-cuttings and plant-chimæras in Pelargonium Plants raised from buds formed on roots may differ from those

raised from shoots, demonstrating the existence of an inner component. The plant may be (1) male only, (2) female only, (3) sterile, whereas the inner component is in each a normal hermaphrodite. The distinction is probably in epidermis alone. Zonal Pelargoniums raised by cross-fertilisation between green and albino tissues show the artificial formation of chimæras. Rothamsted Experimental Station had an exhibit illustrating the inoculation of lucerne with nitrogen-fixing bacteria (Mr. H. G. Thornton and Prof. N. Gangulee). A motile stage has been discovered in the life-cycle of *Bacillus radicicola*, the organism forming nodules on the roots of leguminous plants within which nitrogen is collected and utilised by the plant. This stage is connected with the spread of the bacteria through soil. The results have been applied, with some success, to the practical problem of inoculating the lucerne crop. The National Physical Laboratory showed a Guild colorimeter for fundamental investigations in colour vision (Mr. T. Smith). Light from a single source, after passing through gelatine filters of three selected colours arranged symmetrically about the circumference of a circle, is brought to a common axis by a rotating prism. The mixture thus obtained is presented side by side with the colour to be measured by means of a photometric cube.

AT the Conference of Women in Science, Industry and Commerce, held at the British Empire Exhibition on July 15-18, Miss C. U. Kerr read a paper on the effect of welfare work upon health and efficiency. Miss Kerr outlined the history of the welfare movement and pointed out that the earliest experiments in welfare work were initiated in engineering factories. The chief branches of welfare were considered and a special plea put forward for the adequate provision of food for the workers. Many firms are still without canteens, and those which do have them often fail to see that the food is interesting and appetising. The proper selection of workers was discussed and an interesting suggestion made that many operations could be well performed by people not of robust physique, provided that the conditions were good. The advantage to a delicate person who finds his job and knows he can do it well cannot be calculated only by his efficiency at work; the mental effect is probably the cause of the improvement related by the writer in connexion with a tobacco factory. One would like to see the engineering metaphor disappear from these discussions. The writer of this paper quotes the phrase "Human Engineering" as an apt description of welfare work and calls "food for the producers," "fuel for the human machines." These phrases stand for a mechanical interpretation of life which has been, and still is, the cause of no little trouble in the industrial world. A machine is a means to an end. Can that be true of a human being?

MR. GOYDER, of Mill Hill School, has maintained two-way radio communication with the leader of the MacMillan Expedition in the Arctic. When communication was first established on July 18, the *Bowdoin*, with Captain MacMillan on board, was at Hopedale, Labrador, but on July 24 she was crossing the Arctic Circle. The two ships, the *Peary* and the *Bowdoin*, are proceeding to their base at Etah in Greenland, and it is hoped to make an aeroplane base at Cape Thomas Hubbard in Axel Heiberg Land. Mr. Goyder works with a 250-watt Mullard valve on a wave-length of 40 metres. He only uses a single wire Hertz aerial, but he receives on a special circuit devised by Mr. Reinartz, who operates the radio apparatus on the *Bowdoin*. The messages are received best between midnight and six o'clock in the morning. Mr. Goyder has himself transmitted to America several messages from the explorers to their friends. It will be remembered that he was the first to maintain two-way communication between Great Britain and New Zealand. Mr. Goyder is to be congratulated on his success, which will raise the status of British amateur radio-telegraphy.

AT the annual general meeting of the Marconi International Marine Communication Co., Ltd., held on July 24, Senator Marconi gave an interesting sketch of the lines on which radio signalling is developing on board ship. During the past two years, numerous experiments have been made to find out how far radio telephony is desirable and practicable in the mercantile marine. Trials were made in trawlers as well as in liners, both between ships and between ships and shore. The results obtained prove that there is no technical difficulty in the way of accomplishing a satisfactory service of duplex radio telephony between ship and ship when they are on the high seas and away from the areas of congested radio-telegraphic traffic. In one instance a range of nearly 400 miles was covered. If a demand arises by ship's commanders and passengers, it can easily be met. There is however no likelihood at present of radio telegraphy at sea being superseded by radio telephony. When financial matters are less stringent, it is probable that shipowners with the collaboration of the Post Office will give facilities for conversation between passengers and shore stations. The Board of Trade has recently made a regulation under which the use of a radio automatic calling device is made compulsory for all ocean-going vessels the crews of which number less than 50. Shipowners, however, are appealing against this regulation as they consider that the present time is inopportune for increasing their financial burdens. Senator Marconi said that there has been a rapid increase in the demand for his company's direction finder, which has proved of great value to navigation, especially in foggy and rainy weather. A ship fitted with this device is able to assist other ships in its neighbourhood by sending them their positions.

SINCE the War, France has paid particular attention to securing its economic independence of other nations. Great attention has therefore been paid to developing "la houille blanche," or water power, so called to distinguish it from "la houille noire," or

coal from which thermal power is developed As the total possible power output of the mountain torrents of the Pyrenees and the Alps and of the Rhone, the Garonne, and the Rhine is several times greater than the power equivalent of the present French output of coal, there is plenty of scope for industrial development In connexion with the present exhibition of "La Houille Blanche" at Grenoble (May–November) the *Revue Scientifique* has published an excellent historical and industrial account of the state of the art of hydro-electrics It is interesting to remember that Fourneyron in 1837 installed at Saint-Blasien in the Black Forest small water turbines 31 cm in diameter, producing 60 horse power, the fall being 114 metres The efficiency of the machines was no less than 80 per cent, which is quite comparable with that of the best modern machines In the historical survey an account is given of the work in hydrodynamics done by Pascal, D'Alembert Lagrange, Laplace, Poisson, Cauchy, and others down to Poncelet and Girard Interesting portraits are given of the French scientific workers In the technological section illustrations are given of the chief steam- and water-power stations in France, and methods are indicated for accelerating the development of industry by distributing electric power over wide areas H Parodi, the engineer to the Compagnie d'Orleans, contributes a thoughtful paper on the different policies adopted by the various countries of the world with regard to railways operated by electric traction, and more particularly those which utilise water power through the medium of electricity The curves he gives indicate clearly when electric traction becomes a commercial proposition

THE River Pollution Committee of the Ministry of Agriculture and Fisheries, having learned that the impression prevails in many quarters that the Committee is antagonistic to the use of tar in the preparation of road surfaces, is anxious to correct this impression The Committee is concerned solely with the question of river pollution from the point of view of the fishery interest The constituents of tar, if they find access to a river, are most injurious to fish and their food, and the Committee earnestly advocates the avoidance of the use on any road, the washings from which are likely to find their way directly into a stream, of any road dressing containing tar or tar products Washings from bituminous surfaces are however, innocuous to fish and their food, and the Committee has advocated the use on roads in proximity to streams of bituminous dressings Obviously, the roads with which the Committee is concerned constitute only a small fraction of the total roads of the country The Committee's policy has been solely to urge upon all road authorities that care should be taken to avoid the use of tar at what are the danger points from the point of view of pollution The Committee has examined a number of preparations for road-surfacing, and is prepared, if consulted by road authorities or other persons concerned, to advise them as to the suitability for use in proximity to streams of such preparations as they have examined

HEATHFIELD HALL, Watt's residence at Birmingham, where he lived from 1769 until his death, is now in course of being demolished to make way for new buildings which are to be erected on what was once his estate Fortunately, however, all the machines, tools, benches, etc, from Watt's workshop have been presented by Major Gibson Watt to the Science Museum at South Kensington, where on the ground floor of the new building, not far from three of the engines which were built by the firm of Boulton and Watt between 1777 and 1797, an accurate reproduction of James Watt's workshop has just been completed The present owners have generously presented the door, windows, flooring, etc of the old room, so that it has been possible to produce a replica of the old attic, and in it to arrange the contents as they were at the time of Watt's death The two copying sculpture machines, the lathe, and benches, boxes of tools, tables, etc, take up too much space for the public to circulate in the room, but a large plate glass window in one of the walls allows the workshop and its contents to be seen readily

THE following officers of the Institution of Electrical Engineers have been elected —*President,* Mr R A Chattock, *Vice-Presidents,* Lieut-Col K Edgcumbe, Prof W M Thornton, *Hon Treasurer,* Mr P D Tuckett

AT the annual general meeting of the Royal Society of New South Wales, held on May 6, the following officers were elected —*President* Prof R D Watt, *Vice-Presidents,* Mr J Nangle Mr E C Andrews, Mr C A Sussmilch, and Dr C Anderson, *Hon Treasurer,* Prof H G Chapman, *Hon Secretaries,* Mr R H Cambage and Dr R Greig-Smith

SIR ERNEST and LADY RUTHERFORD left Great Britain for Australia and New Zealand on July 25, on the s s *Ascanius,* bound for Adelaide While their main object is to visit their parents and relatives in New Zealand, Sir Ernest has also promised to deliver lectures on aspects of modern physics in some of the chief cities of Australia and New Zealand They hope to return to England in January 1926

AT the annual meeting of the Museums Association held at Exeter on July 7, the following resolution was passed —"That the Museums Association desires to place on record its opinion that the present reckless destruction of animal and plant life by collectors and others will, if continued, result in a deplorable loss to posterity" Mr J Bailey, late of the Circulating Department of the Victoria and Albert Museum, London, was elected president of the Association for the year 1925–26 The next conference will be held at Bournemouth in July 1926

PROF A A MICHELSON, professor of physics in the University of Chicago, has been appointed to the first of the distinguished service professorships which have been established in that University These professorships form part of a development scheme which, we learn from *Science* has been instituted with the view of raising a new endowment fund of 6,000,000 dollars Special efforts were made to obtain funds

in sums of 200,000 dollars, the incomes from which would be devoted to professorships such as that now conferred on Prof Michelson The present professorship is due to the generosity of Mr M A Ryerson of Chicago, formerly president of the board of trustees and donor of the Ryerson Physical Laboratory of the University

THE autumn meeting of the Institute of Metals is to be held at Glasgow on September 1-4 under the presidency of Prof T Turner Feeney professor of metallurgy in the University of Birmingham The proceedings commence with the fourth autumn lecture, by Sir John Dewrance, who will take as his subject 'Education, Research and Standardisation' Sixteen papers on various aspects of the constitution and properties of metals and alloys are to be submitted for discussion at the meeting The lighter side of the programme announces visits to works and places of interest in the neighbourhood of Glasgow, and special arrangements are being made for the entertainment of the ladies present Railway vouchers enabling members of the Institute and their friends to purchase return railway tickets to Glasgow at the rate of a single fare and a third can be obtained from the secretary of the Institute of Metals 36 Victoria Street London, S W 1

THE Council of the Institution of Electrical Engineers, which took an important part in founding the Society of Radiographers in the year 1920, and, under that Society's constitution, has up to now nominated six out of the eighteen members of the Society's Council has withdrawn its nominees and terminated the Institution's connexion with the Society This action has been taken because the majority of the Council of the Society of Radiographers has resolved upon certain alterations of the Society's articles, with which the Council of the Institution of Electrical Engineers is in entire disagreement, as in the Council's opinion these alterations will materially lower the professional status of non-medically qualified radiographers

APPLICATIONS are invited for the following appointments, on or before the dates mentioned An advisory agricultural economist at the Seale Hayne Agricultural College, Newton Abbot—The Secretary and Bursar (August 4) A second assistant in botany in the University of Aberdeen—The Secretary (August 19) An assistant lecturer in physics at the University College of Wales, Aberystwyth—The Secretary (August 30) A laboratory assistant for the Veterinary Research Department of the Government of Uganda—The Crown Agents for the Colonies, 4 Millbank Westminster S W 1 quoting M13/800

Our Astronomical Column

THE JULIAN DAY —A matter that excited much interest was settled by the International Astronomical Union after a long discussion by a considerable majority When it was decided that the astronomical day should begin at midnight instead of noon a diversity of view was manifested as to whether the Julian day should follow suit, or begin at noon, as heretofore Speaking broadly, the former view was held in America, the latter in Europe The matter is of especial importance for variable-star observers, since it has for long been the custom to use the Julian day both for the elements of these and for recording observations

It was further pointed out that the whole point of the institution of the Julian day system was to have a method of recording time that should be independent of all changes of style or calendar changes and that once established such a system should not be lightly broken It was indeed admitted that there had been a change of two hours since its institution, its beginning was then noon at Alexandria, afterwards altered to Greenwich noon However a change of two hours applied to comparatively rough early observations is of little moment compared with a change of twelve hours in accurate modern observations Many of the Americans including Prof Shapley, admitted the force of these arguments and supported the retention of the noon beginning, which was afterwards confirmed by the Union as a whole

An endeavour was also made to agree on a name for the new astronomical day that begins at Greenwich midnight A very large section expressed disapproval of continuing to use the phrase Greenwich Mean Time for the new system, but no alternative was found that commanded general assent, it was agreed to leave the matter open, as being comparatively unimportant, provided one made clear what time-system one was using The title "Universal Time" met with most support and the Astronomer-Royal said he would endeavour to get this name inserted in the Nautical Almanac as a second title Greenwich Mean Time continuing to be the first title

PERTURBATIONS OF MINOR PLANET 944, HIDALGO — Discovered by Dr Baade of Bergedorf in 1920 Hidalgo is one of the most interesting of the minor planets being near the orbit of Mars when in perihelion, and near that of Saturn when in aphelion Its period, $13\frac{3}{4}$ years, does not differ greatly from that of Jupiter, its orbit is inclined to the ecliptic at the high angle of 43° the greatest of any minor planet However, its passage of the descending node takes place not more than half a unit from Jupiter's orbit, and the question of the perturbations by the latter is of interest Mr K Jantzen investigates the secular perturbations by Jupiter in Bulletin of Vilno Observatory No 5, using the method given by Hills in vol 1 of the Amer Ephem Papers The circle of eccentric anomaly was divided into 192 parts, this large number being necessary owing to the near approach to Jupiter's orbit, which occurs when $E = 83°$

The final values of the secular perturbations of the elements are $e + 14''4$ $i - 16''2$, $\Omega - 26''5$, $\pi - 65''3$, $L + 57''6$ The method of special perturbations would have to be used at the time of a near approach of the two bodies, there was actually a fairly near approach (less than an astronomical unit) in 1922 This was probably the closest in the last century or thereabouts

Some authorities are inclined to rank this body as a comet rather than a planet It seems, however, better to limit the term comet to bodies showing nebulosity Hidalgo always appeared stellar

Research Items

THE "LOST CITY OF NEVADA"—Dr M R Harrington, of the Museum of the American Indian Heye Foundation, contributes to the *Scientific American* for July an account of the excavation of the Pueblo Grande de Nevada, also known as the "Lost City," which began in November last This settlement is probably one of the oldest in North America, north of Mexico, antedating the cliff dwellings of New Mexico and Arizona It lies scattered along the banks of the Muddy River over a distance of five or six miles, with a greatest breadth of a mile About thirty houses have been uncovered On the floors and in graves have been found implements of bone and stone, pottery and ornaments of shell and turquoise The inhabitants gathered wild natural products, but also farmed, raising corn, beans and squashes They had no domesticated animals except the dog and hunted deer, mountain sheep, and the jack rabbit, though the bones of game animals are not numerous Considerable progress had been made in weaving and dyeing The pottery has a general resemblance to Pueblo but belongs to an early period, while the dwellings are of the primitive type consisting of an oval pit two or three feet deep, which must have had a superstructure of poles and matting The development in type of the dwelling shows that Pueblo Grande belongs to the close of the pre-Pueblo and the beginning of the Pueblo period

DECORATIVE DESIGNS ON CARVED WOODEN FOOD-BOWLS, PORTUGUESE EAST AFRICA —Some interesting notes on the origin of the decorations on carved wooden food-bowls among the Va-Lenge and Va-Chopi of Portuguese East Africa are contributed by Miss E Dora Eady to Vol 11, Part 2, of the Annals of the Transvaal Museum Both peoples have an elaborate system of hair dressing, varying with the great social events and crises of their life The food-bowls, generally circular in shape, when turned upside down are regarded as human heads, and the little plaitings of the hair which are grouped together in a triangular shape are reproduced on them as incised triangles A notched arrangement, forming a series of lozenges at the base of each triangle is also copied from the hair, though on the bowls the place of the lozenge is sometimes taken by a chevron The absence of the chevron or lozenge on the bowl pattern represents the hair of widows and uninitiated girls If the lozenge is very small it indicates an initiated girl or one ready for marriage The chevron means that the woman's husband is ill, some think recently deceased A hair-parting encircling the head is also reproduced on the bowl where by some it is said to represent the line of scalping or decapitation followed formerly when the Va-Chopi were head-hunters

AMERICAN OAKS —The twentieth volume of the Memoirs of the National Academy of Sciences (U S A) is devoted to a monograph by Dr Wm Trelease of the oaks inhabiting the New World Although the oaks of the United States and Canada have been reviewed from time to time by Sargent and other American botanists, no such comprehensive work as this, which deals with the genus Quercus as represented on the entire continent, has appeared before The region occupied by the American oaks extends from Canada southwards to the Columbian Andes and Cuba, the greatest aggregation of types occurring in the highlands of Mexico Dr Trelease divides them into three main sections, namely, the white oaks (Leucobalanus), the red oaks (Erythrobalanus), and a small intermediate oak (Protobalanus) These sections are subdivided into numerous groups, for each of which a detailed general description is provided, the individual species being differentiated by one or more leading characters only, but new species, of which the author has made a considerable number, are described in full The geographical range of each group and species is defined, and an adequate, though not necessarily complete, synonymy is given The real value of such a work as this can only be appreciated of course by long and continued use, but there can be no doubt that it has simplified for the student the very intricate and difficult problem of the American oaks, and brought into convenient compass a vast amount of exact information concerning them The introductory essay, dealing with the history of the genus, details of structure in stem, leaf, flower and fruit, taxonomy, geographical distribution, hybridity, and the fossil botany of oaks, is admirably written For the purpose of preparing this monograph, which is illustrated by 420 plates, the author has studied the material in all the great herbaria of the world

LEAF SHAPE —The factors controlling leaf shape are undoubtedly various and differ under different conditions, but Dr W H Pearsall and Miss Alice M Hanby seem to throw some light upon them in the experimental study of *Potamogeton perfoliatus*, which they report upon in the *New Phytologist*, vol 24, No 2 Using Pond's method of enclosing the root system in one culture solution and the submerged shoot system in another they are able to analyse the effect of different solutions upon growth Their results make clear the great importance of the ratio of calcium to potassium and sodium ions in the solution upon the relative length and breadth of the leaf, whilst their analysis of this difference shows it must be attributed to a different activity of the meristem when growing in solutions which vary in the relative proportions of these ions Their conclusion is that with this variable species, changes in leaf form are usually determined under natural conditions by the calcium content of the soil and to a less extent by light

ON AMMONITES VIA NAUTILUS —A paper by Martin Schmidt entitled "Ammonitenstudien" (*Fortschr Geol und Palaontol* Hft 10) covers a far wider field than its title would indicate The first portion, illustrated by an excellent plate treats of new and little-known Ammonites from the Schwabian Lower Lias The second portion contains a general summary of what is known concerning Nautilus including a histological section by Max Rauther followed by an attempt to apply that knowledge to the study of the Ammonites The author favours the idea that the Ammonites were plankton feeders and their successive modifications and destruction were entailed by the altered habits and extinction of their food

PALÆONTOLOGICAL HISTOLOGY — The Nigerian Government has published (Geological Survey of Nigeria, Occasional Paper No 2) an account by Baron Nopcsa of some fragments of fossil reptiles from Sokoto These are for the most part Crocodilian or Deinosaurian but are too fragmentary to yield much information beyond the suggestion that the beds in which they occur are Lower Eocene in age The chief interest in the paper lies in the application of histological methods to palæontology, whereby it seems possible from the structure of the Haversian canals to distinguish Crocodilia from Deinosauria

Further investigation along these lines should lead to interesting results

ARCHÆOPTERYX —Dr Petronievics has continued his investigations on the genus Archæopteryx, which he began upon the specimen in the British Museum, by a study of the example in Berlin From a comparison of the two he comes to the conclusion that so far from being the same species, they represent two different sub-classes of birds For the British Museum specimen he retains the name Archæopteryx, and calls the Berlin one Archæornis The first is considered to be a primitive ratite and the second a primitive carinate In general Archæopteryx shows the more primitive characters of the two The author comes to conclusions, which are certainly not those of the text-book, that the ancestor of birds is to be sought in a primitive group of the Lacertilia and that the resemblances which have led investigators to see some affinity between birds and the Deinosaurs are to be interpreted as due to convergence The paper is published in the *Annales Geologiques de la Peninsule Balkanique* vol 8 1925

THE MINERAL IDDINGSITE —The red-brown alteration product of olivine known as iddingsite has become very familiar to petrologists during the last thirty years, but hitherto its nature and properties have been only vaguely realised C S Ross and E V Shannon have now presented a careful study of the material in the Proc U S Nat Museum, vol 67, No 2579 1925 They conclude that iddingsite is not a product of weathering, but is the result of metasomatic processes associated with the later stages of a cooling magma It forms from olivine soon after the close of crystallisation under conditions of oxidation and hydration MgO is abstracted, FeO is oxidised to Fe_2O_3 and water is added and the resulting product has a formula of the type $MgO\ Fe_2O_3\ 3SiO_2\ 4H_2O$ The optical properties are distinct and different from those of any other described mineral, including serpentine, which differs in mode of origin, chemical composition, and physical properties Iddingsite is therefore regarded as a definite mineral species

THE GEOLOGY OF NORTH LONDON —Under this title the Geological Survey of Great Britain issues an explanation of one-inch Sheet 256 England, by C E N Bromehead, with contributions by H G Dines and J Pringle The area comprised includes London north of the Thames and the surrounding country as far north as Watford and Enfield The whole ground has now been surveyed on the six-inch scale but a large proportion of the area has been built over and more is still "under development" so that there are few open sections available for study Save for brief allusion to the older rocks the formations dealt with range from the Upper Chalk to the Alluvial Despite the evidence of palæontology, the Glacial deposits are still placed at the beginning instead of the close of the Pleistocene period, and though many of the Pleistocene mammalia are duly chronicled, we miss all reference to *Rhinoceros tichorhinus*, a fine skull of which, now in the British Museum (Natural History), was found at Perivale in the Brent valley, and recorded so far back as 1913

PERIODIC CHEMICAL CHANGES —A further paper on periodic chemical phenomena by E S Hedges and J E Myers appears in the Journal of the Chemical Society for May Typical periodic reactions have now been investigated from an electrochemical point of view In the case of activated metallic couples dissolving in hydrochloric acid or ammonium chloride, the potential difference between the couple as a whole and the solution, and that between the two components of the couple, undergo periodic fluctuations which synchronise with the periodic evolution of gas A potential difference exists between the active and inactive forms of a metal The periodic deposition and dissolution of iron on magnesium in an acid solution is investigated together with a few other similar cases A corresponding oscillation of the electropotential occurs and often there is a periodic evolution of hydrogen Examples are given of "autoperiodic" reactions where one electrode serves both as the reacting metal and as the activating agent The results are correlated with those of previously published investigations

A VACUUM THERMO-ELEMENT —A number of instruments have recently been described for spectroscopic observations, and for the direct measurement of the radiation of the stars, in which a thermo-element consisting of two thin wires of different metals soldered together with a small receiving plate attached to the junction is mounted in a vacuum Messrs W J H Moll and H C Burger criticise this arrangement in the *Zeitschrift fur Physik* of June 5, pointing out that it is slow in action, owing to the mass of solder necessarily added at the junction They describe a method in which the edges of two plates of constantan and manganin a few millimetres thick are soldered together with silver and then rolled out in the direction of the soldered junction to about 1 μ thickness The result is a long thin ribbon of foil, one-half of constantan and the other of manganin soldered together along the length of the ribbon by a thin line of silver Narrow strips at right angles to the length can be cut from this, and it is even possible by etching to obtain a small receiving disc about the junction, with narrow strips of foil on either side, which can be soldered to the supporting wires Such an element can be mounted in an evacuated bulb of glass or quartz, which can be sealed off permanently and when this is enclosed in a double copper vessel with small windows, it makes a very sensitive and rapidly adjusted instrument

STANDARDISATION OF SIEVES —In an article in the June issue of *State Technology*, Mr P E Masters directs attention to a difficulty under which British manufacturers who require to sift fine material labour owing to the absence of any satisfactory standard to which sieve makers can work A sieve of 80 meshes to the linear inch may be made of wire of gauge from 38 to 42 according to the will of the maker, and the user of the sieve only discovers a change of gauge by some serious modification of the properties of the sifted material The proposals of the Institution of Mining and Metallurgy for standard sieves involve the use of wires not of standard gauges and the sieves are so difficult to manufacture that high prices are quoted for them The author proposes that the standard relation between the diameter d of the wire and the distance D of the centre lines of consecutive wires apart shall be $D = 2\ 7d$ This gives as the proper wires for 10 20, 30 and 40 meshes to the inch, gauges 19, 25 29 and 33 respectively, for 60, 80, 100, 120 140 and 160 meshes gauges 37, 40, 42, 44, 45 and 46 respectively, and for 200 meshes, gauge 47 wire

ERRATUM —In NATURE for July 11 p 61, col 1, paragraph 2, line 13 the words "It is also a genus long known only from Europe" should refer to Balanocrinus

The International Astronomical Union at Cambridge

WELCOMED by Lord Balfour, Chancellor of the University of Cambridge, who dwelt on the value of international co-operation, by Dr J H Jeans, president of the Royal Astronomical Society, who dwelt on the revolutions that astronomy has compelled in human thought, and by the Astronomer-Royal, who gave a short account of the manifold activities of the Union since its birth in 1919, the conference made a happy and successful start on July 14 in the Senate House of the University In his address at the opening meeting of the general assembly of the Union, at which there were present more than 200 national delegates, members of the Union and invited visitors the president Prof W W Campbell, reminded the Union that it is charged with the care of international co-operation in astronomy wherever it is necessary or useful The principal fields of astronomical activity are represented by more than a score of committees, their reports refer to great pieces of work in which there are many students, where co-operation is required to secure a fairly homogeneous system over the entire field He illustrated the point by a short historical account of the study of the variation in latitude We have now a very good knowledge of the conditions that are requisite for success in astronomical co-operation, and in launching fresh schemes, as the Union must do from time to time, we must beware of starting on new and untried work with too ambitious a programme Prof Campbell added a strong and evidently welcome tribute to the work that the general secretary of the Union, Prof A Fowler, has done for it since its foundation

Dr G Abetti, Dr H Chretien Lieut-Col F Stratton, and Dr F Henroteau were appointed recorders for the meeting, and Dr A Wolfer was appointed vice-president for the meeting in the absence of Prof K Hirayama

It was announced that Norway, Spain, Portugal and Switzerland are now full members of the Union, and the adherence of Sweden has been officially notified There are now 22 countries in the Union, and 20 of these were actually represented at the conference After considerable discussion resolutions submitted by constituent bodies of the Union were submitted to committees save one from the United States This was a proposal that the Committee on Selected Areas should be invited to reorganise itself under the auspices of the Union The motion was deferred until such time as Germany becomes an adhering country of the Union, a necessary condition which the American committee had hoped to see fulfilled at the Cambridge meeting

The Union then dissolved itself into 27 committees which for the next four days dealt faithfully each with its appropriate portion of the 122 pages of the report prepared by Prof Fowler It is impossible here to do more than mention very briefly some of the more important resolutions of wide interest which were ultimately adopted by the General Assembly of the Union

The committee on standard notations appointed a sub committee to report to the Union at a later date on a revision of the boundaries of the northern constellations Different systems adopted by earlier writers have led to an annoying confusion in the double names allotted to stars near the boundaries of constellations

It was agreed that for all telegrams transmitted from the Bureau at Copenhagen, mean places should be adopted, referred to the equinox at the beginning of the year Where desired, adequate descriptions of newly discovered objects should be given

A grant of 250*l* a year for three years was made to Prof De Sitter to carry out a programme of observations of azimuth at an equatorial station and at northern and southern stations, for the determination of fundamental declinations, the instrument and the observer are to be found by the Leyden Observatory A revised list of stars to form, or to be developed into, a *fundamental* list was also adopted and recommended for as continuous observation as possible The further study of the variations of refraction at different hours of the day and in different parts of the sky was also recommended It was announced that Greenwich, the Cape and the Naval Observatory at Washington are to co-operate with the German astronomers in the observation of reference stars in connexion with the coming opposition of Eros in the year 1930–31

With regard to solar physics it was agreed to arrange that additional observations of the sun as nearly continuous as possible should be made at or about the time when magnetic storms are in progress or expected There would have to be organised some service to supply the necessary information to the co-operating observatories The view was expressed by M Deslandres and adopted by the Union that it is important for the variation of the solar constant, announced by Dr Abbot, to be studied in other countries, especially in reference to accompanying changes in meteorological elements Strong support was given to the suggestion that a Solar Physics Observatory should be established in Japan With regard to apparent changes in solar rotation, Dr St John announced that the Snow telescope as used by Adams would be reconstituted to compare its results with those given by the 150-foot tower telescope

Several important resolutions were adopted as to standard wave-lengths Of these the most important was the following

The primary standard of wave-length, λ 6438 4696 of cadmium shall be produced by high voltage electric current in a vacuum tube having internal electrodes The lamp shall be maintained at a temperature not higher than 320° C, and shall have a volume not less than 25 cubic centimetres The effective value of the exciting current shall not exceed 0 05 ampere At room temperature the tube shall be non-luminous when connected to the usual high voltage circuit So long as the lamp used is capable of giving well-defined interference fringes with retardations of at least 200 000 wave-lengths it is not however, necessary to specify the volume of the tube serving as lamp The primary standard should always be produced in a lamp which is ascertained to give retardations of at least 200,000 wave-lengths

General Ferrie announced that the world scheme for the wireless determination of longitudes as approved at Rome has been worked out in further detail experiments of considerable interest with diverse optical instruments have been carried out at Paris to check the conflicting views as to the relative success of small field instruments and large observatory transit circles A number of resolutions as to the details of the scheme were adopted Some preliminary experiments are to be carried out during the two months commencing October 1, 1926

A strong wish was expressed by the Union that the U S Coast and Geodetic Survey should re-establish the latitude station at Gaithersburg so as to renew its co-operation in the study of the variation of latitude The help of meridian observers in securing fresh

determinations of the declinations of the stars involved in this work was also strongly urged

A research survey for all the minor planets giving a record of available fundamental investigations on the perturbations of minor planets was approved by the Union on the suggestion of Prof Leuschner

Observatories with suitable instruments were asked to arrange to secure annually photographs of the meteors of the three annual showers the Perseids Orionids and Geminids

Welcome news was given by Prof Turner as to the progress of the *Carte du Ciel* France and Italy hope to complete their zones in eight years time or sooner The chief delays are at Tacubaya and Sydney, and the Union appealed to the two governments concerned for more rapid prosecution of the work

In parallax work it was recommended that observers of trigonometric parallaxes should shape their programme, so far as possible, to meet the needs for spectroscopic and dynamical determinations Faint stars of large proper motion are especially important It was also agreed that photometric observers should be urged to determine carefully the magnitudes and colour equivalents of these stars

Prof von Zeipel reported through the Committee on Photometry that at Upsala it is proposed to determine the photographic and photovisual magnitudes of the 11 700 stars in the A G catalogue between $+35°$ and $+40°$

A grant of 6000 francs was made to Dr Aitken at the Lick Observatory for the clerical work of the Double Star Bureau in connexion with the extension of Burnham's General Catalogue The use of the reversing prism in determining position angle in double stars was also approved

During the meeting co-operative work on the important Cepheid variables was arranged As to notation the Union supported that of Chambers—Andre—Nijland A list of variable stars needing special attention drawn up by Prof Nijland, was published in the report of the Committee on Variable Stars

It was agreed that a new catalogue of the brighter and larger nebulæ should be drawn up, illustrated by plates and including globular clusters The system to be adopted for classification is to be purely descriptive It was also recommended that in published work on nebulæ the N G C or I C number should always be used, and that steps be taken to divide the sky into zones allotted to different observatories for work on agreed lines on nebulæ It was also agreed that observatories should be encouraged to publish, whenever possible, copies of their best spectrograms This would be of assistance for the next stage in stellar spectral classification A small catalogue of some 20 to 25 stars is to be prepared to serve as standards in radial velocity work

Important resolutions were adopted amending the forms, times and modes of emission of radio time signals For the international time system at certain times it was agreed to replace the present three dashes by six dots

The above brief summary of the more interesting resolutions indicates that a large volume of work was got through in the various committees In addition much valuable material is incorporated in many of the reports of the committees especially in the accounts of recent work It is to be hoped that the volume of proceedings may shortly be available to the public The reports of the committees were for the most part taken without discussion at the general assembly in its closing meetings the one fight being over the question of the hour of commencement of the Julian day By a large majority it was agreed that this should remain at noon The failure of the International Research Council at its recent meeting at Brussels to make any change in the statutes governing the conditions of national adherence led to a number of statements being made by the various national delegations The United States Italy, Japan, Spain Denmark, Sweden, and Canada urged that all restrictions should be removed, while Belgium France Poland Czecho-Slovakia Portugal and Rumania contented themselves with asking the International Research Council not to block the admission of the Central Powers when they became members of the League of Nations

The next meeting of the Union was arranged, on the invitation of the Dutch government to take place in Holland in 1928 The committees of the Union were appointed for the next three years, including new committees on stellar statistics and on solar parallax Officers of the Union for the next three years were elected as follows —Prof De Sitter (president) Profs Cerulli Deslandres, Hirayama, Eddington and Schlesinger (vice-presidents), Lieut - Col Stratton (general secretary)

A very successful meeting closed on July 22 Generous hospitality was shown throughout by the Colleges Amongst many interesting points referred to in the side meetings was an announcement that Prof Adams has measured the Einstein shift in the spectrum of the companion to Sirius The result is consistent with the theoretical view already announced, that this star, though 2000 times as dense as platinum, obeys the gas laws

The Field Museum of Natural History, Chicago

THOSE connected with museums in Great Britain generally read the annual reports of museums in the United States with some envy This is partly because those reports are produced in a style to interest the reader and to do credit to their institutions, partly because of the vigorous work they reveal The chief factors, no doubt, are brains and enthusiasm but these cannot operate without the other factor—sufficient funds The report of the Field Museum of Natural History, Chicago, for 1924 which s just to hand, illustrates these points It consists of 115 pages, of which half give a readable account of progress, and it is illustrated by 16 photogravure plates prepared in the Museum, as are all the Museum publications That is how it is possible for the volume to bear the date January 1925

The Field Museum corresponds to our own Natural History Museum plus a department of anthropology Its scientific staff, exclusive of the Director numbers only twenty but its expenditure last year was about 117,370*l* The expenditure of our Natural History Museum for last year was about 97,925*l* and the scientific staff numbers forty-three permanent and thirteen temporary members

The extension work of the Field Museum in public schools, the reproduction of living plants in models, and the pensions to employees are provided for by separate funds Setting those activities aside, one notes that about 5000*l* was spent during the year on expeditions then there are three guide-lecturers, who besides conducting visitors, give regular lectures illustrated by lantern and cinematograph the printing has already been mentioned, but it should be added that this includes a large number of coloured posters

and advertisement folders. Such are a few of the lines of work in which British museums of similar size and character cannot compete. This expenditure, however, cannot be regarded as wholly unproductive, for it must certainly attract a large number of subscribing members. In Great Britain most museums are maintained by compulsory imposts, and free gifts of money are harder to come by. Whatever may be the relative advantages or disadvantages, it is certainly creditable to the citizens of the United States that they support so many admirable museums by private generosity.

From the body of the report a few items may be selected as continuing the contrast. Leakage through the roof of the top lighted halls has been remedied in drastic fashion by coating the 38,500 square feet of skylights with a double thickness of Celotex overlaid with Ruberoid roofing. This has involved a change in the lighting of the halls from daylight to electric light. Making a virtue of necessity, it is claimed that artificial lighting is more suitable for the exhibited material because the illumination is more uniform and avoids the fading effects of sunlight. Since many American museums have long surpassed those in Britain in the use of electric light, we may be sure that some of the 'dazzle headlight' effect recently introduced into one of our largest metropolitan museums has been avoided; but we are not so sure about the fading.

A somewhat full account is given of the re-erection of two Mastaba tombs from Egypt. The blocks arrived in 206 cases weighing 96 tons. The lower courses and missing stones have been replaced by cement blocks. The stones are bedded in lead, joined by dowels and metal clamps, and each secured to a bracketed upright steel channel. The ceiling has been raised 18 in. above the walls, and hidden lights are in a trough on the top of the wall. Every care has been taken to prevent humidity, and the room at the back of the tombs is mechanically ventilated. These and other details are given in the report "in the hope that the information may prove useful to other institutions." The use of terms unfamiliar, at least in Great Britain, and the absence of illustrations will, it is to be feared, frustrate this hope.

A poisoning and storage room, apparently in five sections, for the preservation of perishable material has been constructed of compressed steel and equipped with storage bins of cedar wood. Formaldehyde candles have been used for poisoning with good success.

Many British provincial museums have long experienced the popularity of a wild flower exhibit, but none of them has attempted to show living and growing wild plants on anything like the scale attempted last year in the Field Museum. The case was a kind of large flower-box, and soon proved so successful that it was replaced by one four times the size, permitting of an approximately ecological grouping, which ranged from sand-dune plants to water plants. During the season about 500 species were shown, with full labels and guide leaflets.

Though not of such interest to the public, the numerous paragraphs revealing what careful attention is paid to storage, unpacking, sorting, and general office equipment will be read with appreciation by all museum curators. Nothing is more difficult to impress upon governors, committees, architects, and providers of funds than the fact that the life of a museum is in its workrooms and workshops, and that in any plans for development the first attention should always be paid to those unseen but indispensable offices. What is a banqueting hall without its kitchen? We can better dispense with the toastmaster than with the cook.

F. A. BATHER.

The Sixth International Conference of Pure and Applied Chemistry

SOME seventy foreign delegates, representing twenty different countries, attended the conference which was held recently in Bucharest. The decoration of railway stations and of public buildings and the more than generous hospitality provided by private individuals, public officials and organisations throughout the duration of the conference indicated how important the event was considered in Roumania, and demonstrated the sympathetic attitude of its people towards chemistry.

The actual business of the conference was transacted on June 22-June 25 under the presidency of Sir William Pope, and the other British delegates were Prof. J. C. Drummond and Prof. C. S. Gibson. The prestige of British chemistry can scarcely be said to have been adequately maintained since Denmark, the United States, Spain, France and Italy were each represented by a larger number of delegates than Great Britain. At the opening official reception, H.R.H. the Crown Prince of Roumania was present and, later, representative delegates were entertained by their Majesties the King and Queen at the Royal Palace at Sinaia.

Apart from the work of the special committees which met in the mornings and afternoons, a discussion on 'The Nitrogen Problem,' in which Prof. F. Giordani of Naples and Prof. D. Staehelin of Bucharest took part, was of special interest in connexion with the natural resources of Roumania. Public lectures were also delivered by Prof. Charles Moureu and Prof. Ernest Fourneau on "Autoxidation and Catalytic Phenomena" and "The Relationships between the Chemical Constitution of Substances and their Physiological Properties" respectively.

At the closing meeting Prof. Ernst Cohen of Utrecht was unanimously elected president of the Conference in succession to Sir William Pope, who, like his predecessor Prof. Moureu, has held this important office during three years. Mr. Jean Gerard was re-elected secretary and the following were appointed vice-presidents for the ensuing year: Profs. Bertrand (France), Minovici (Roumania), Nasini (Italy), Norris (America), Pictet (Switzerland) and Swarts (Belgium). The invitation from the United States to hold the next conference in Washington in September 1926, on the occasion of the fiftieth anniversary of the American Chemical Society, was cordially accepted.

An unique opportunity of seeing something of the enormous natural resources of Roumania was afforded to the delegates by the visits to the factories at Medias and Diciosanmartin, where natural methane is used not only as a source of heat and power, but also for the production of cyanamide. At the present time, the economic development is in its infancy, and there are still great possibilities for the scientific exploitation of methane of 99 per cent. purity issuing from the earth at a pressure of 20 to 30 atmospheres. The oil refinery of the Steaua Romana Company and the famous salt mines at Slanic were also inspected, and at all these places the same kindliness and hospitality were freely extended to the delegates.

The Bucharest conference was a model of efficient organisation, and Prof. Minovici and his committee have earned the sincere thanks of those privileged to attend and to join in the excursion to Constantinople, which was a *grand finale* to a most wonderful experience.

C. S. GIBSON.

Wheat Supply and Demand[1]

THE three issues of "Wheat Studies" noticed here form the preliminary instalments of a monthly series which the notice states is "designed to give a sound impartial review of the world wheat position and outlook, based upon careful analysis of the various elements in the situation, with due recognition of economic conditions in exporting and importing countries" Numbers 1 and 3 form a continuous record of the vagaries of the wheat market over a period of seventeen months, when the market situation changed from that of being a buyers to that of a sellers' market, thus allowing of contrasting conditions being compared equitably under almost uniform conditions of exchange and dietary habits

No 2 is a bibliography of the sources of the data upon which the main thesis is based

The cause of low prices in 1923–24 the rise toward the end of the year, the reasons for export by Soviet Russia though crops were insufficient for home needs, and the cause of a marked increase in Oriental demand are all passed under review, and in a quite untechnical manner are explained

Many interesting and important facts are deduced from the mass of statistics handled by the authors Dietary changes due to better conditions among the artisan class since the War are having a significant influence upon the *per capita* consumption of wheat In Great Britain the direction is downward, more meat being eaten but in Scandinavia the same underlying cause promotes an upward movement owing to the falling off in rye consumption

Figures are quoted showing that imports are not governed so much by the state of the home crop as by the state of the market Abundant crops at home and abroad in 1923–24 were accompanied by a large increase in imports into Great Britain Japan and China were attracted by low prices and consumed a quantity of wheat which is not likely to be a standard demand under the conditions which developed at the end of 1924 One of the most interesting sections of the survey is that explaining the effect of crop prospects changes political disturbances of the nature of presidential elections and geographic considerations such as the closing of navigation on the Great Lakes, on the course of wheat prices at Liverpool, Winnipeg, Chicago and Buenos Aires A remarkably close correlation can be traced in almost all cases

The series is the result of team-work and very little time elapses between the data becoming available and the publication of the analysis Under such conditions the readableness and accuracy of "Wheat Studies" are all the more praiseworthy

[1] "Wheat Studies of the Food Research Institute, vol 1 (Stanford University California) No 1 The World Wheat Situation 1923–24 a Review of the Crop Year No 2, Current Sources concerning Wheat Supplies Movements and Prices a Select List with Comments No 3, Developments in the Wheat Situation, August to December 1924

Symbiotic Micro-organisms

IN an article in *Scientia* (April 1925) Prof U Pierantoni, of Turin, who has taken a leading part in the investigations on physiological symbiosis, points out that recent researches in this domain have revealed the existence of micro-organisms which are not only useful but also, in the majority of cases, necessary for the life of the superior organism in which they occur, and they are transmitted from parent to offspring These researches have also made known a new category of organs—termed mycetomes—which owe their functions to the presence in the protoplasm of their cells of symbiotic organisms, so that these by their specific activity determine the action of the organ These symbiotic organs are glands the protoplasm of the cells of which, instead of elaborating products of secretion, foster micro-organisms which produce secretions useful to the organism

The author states that the useful species of micro-organisms outnumber the pathogenic species Among the examples of symbiotic organs to which Prof Pierantoni refers are the luminous organs of cephalopods (Heteroteuthis Rondeletia, Sepiola) which he has investigated, and the luminous organs of certain fishes (Anomalops Protoblepharon) investigated by Prof E N Harvey He points out that these organs are simply cutaneous invaginations which harbour the micro-organisms, and that the thin walls in contact with rich vascular networks protect the cultures while the blood provides the nutrient material required by the micro-organisms The latter multiply and produce continually new luminous substances which replace those expelled from the organ to the exterior by muscular action under nervous stimulation In some cases reflectors and refractors are formed from the neighbouring tissues, these render the light emitted more brilliant

Another important group of symbiotic organs is the mycetomes in the wall of the intestine and associated organs—*e g* in larval and adult insects which feed on wood and blood and in ticks—which elaborate ferments that facilitate the digestion of wood, cellulose, chitin, etc A third group of these symbionts is chromogenic The author observed in 1912 that in certain homopterous insects the symbiotic organ exhibited a bright colour which he attributed to the contained micro-organisms Other investigators have recently found that the red lac of India produced by the coccid *Tachardia lacca* results from the activity of a micro-organism, allied to the Blastomycetes which has been isolated and cultivated The absorption spectrum of red lac exhibits an affinity with that of carminic acid (from cochineal also the product of a coccid) and of the red products of the chromogenic *Bacillus prodigiosus* Prof Pierantoni believes that we are only at the beginning of a line of inquiry likely to be rich in results in pure and in applied science

University and Educational Intelligence

BIRMINGHAM —Applications are invited for the Walter Myers Travelling Studentship in Pathology value 300*l* Information concerning the studentship can be obtained from the Dean of the Medical Faculty of the University The latest date for the receipt of applications is September 1

BRISTOL —In connexion with the recent meeting of the British Medical Association at Bath the honorary degree of LL D has been conferred on Sir Humphry Rolleston, Bart, Regius professor of physic in the University of Cambridge and president of the Royal College of Physicians

DURHAM —At a meeting held on July 27 the Council of Armstrong College, Newcastle-upon Tyne, appointed Prof J W Bews, of Natal University College, Pietermaritzburg to be professor of botany in succession to Prof M C Potter retired Dr Bews is a native of the Orkney Islands and was educated at Kirkwall and at the University of Edinburgh He has been a lecturer in botany at the Universities of Manchester and Edinburgh, and since 1910 has been professor of botany at Pietermaritzburg His publications include "Grasses and Grasslands of South Africa" (1918), "Flora of Natal and Zululand"

(1921), "Plant Forms and their Evolution in South Africa" (1925), and numerous papers dealing with plant distribution in South Africa.

EDINBURGH.—At the Graduation Ceremonial on July 22 the following were among the honorary degrees conferred:—*LL.D.*: Brig.-General the Hon. C. G. Bruce, chief of the Mount Everest Expedition; Prof. A. S. Eddington, Plumian professor of astronomy and natural philosophy in the University of Cambridge; Prof. R. Muir, professor of pathology, University of Glasgow; Principal C. Grant Robertson, University of Birmingham; Sir H. J. Stiles, Regius professor-emeritus of clinical surgery in the University of Edinburgh.

The degree of *D.Sc.* was conferred on the following:—Mr. A. C. Aitken (Thesis—"The Graduation of Observational Data"); Dr. F. J. Browne (Thesis—"Observations on Still-Birth and Neonatal Death, their Causes, Pathology and Prevention"); Mr. A. T. Cameron (Thesis—"Contributions to the Bio-Chemistry of Iodine and the Thyroid and Related Problems"); Mr. G. Harrower (Thesis—"A Study of the Hokien and Tamil Skull"); Mr. J. B. Shoesmith (Thesis—"The Influence of the Nature and Position of Atoms in Organic Compounds on the Reactivity of other Atoms in the Molecule").

LONDON.—Mr. J. S. Huxley, fellow of New College, Oxford, and senior demonstrator in the Department of Comparative Anatomy, has been appointed to the University chair of zoology tenable at King's College. Prof. Huxley was educated at Balliol College, Oxford, where he was Brakenbury Scholar, and also studied at the Stazione Zoologica, Naples, and at Munich and Heidelberg. From 1913 until 1919 he was assistant professor of biology in the Rice Institute, Texas, where he entirely organised the Department of Biology. He helped to organise and took part in the first Oxford Expedition to Spitzbergen in 1921, and in 1924 he visited numerous universities in Canada and the United States. His publications include "The Individual in the Animal Kingdom" (1911), "Essays of a Biologist" (1924), and numerous papers in the Philosophical Transactions and Proceedings of the Royal Society, the *Quarterly Journal of Microscopical Science*, and in other scientific journals; he is also assistant editor of the *British Journal of Experimental Biology*.

Dr. L. Rodwell Jones, Cassell lecturer in commerce in the London School of Economics, has been appointed to the University chair of geography tenable at the School.

Mr. E. C. Titchmarsh, senior lecturer in mathematics at University College, has been appointed to the University readership in mathematical analysis tenable at the College. Mr. Titchmarsh had a distinguished career in mathematics at Balliol College, Oxford, and is the author of numerous papers in the Proceedings of the Royal Society, London Mathematical Society, and the Cambridge Philosophical Society.

The title of reader in medical protozoology in the University has been conferred on Mr. J. G. Thomson, lecturer in protozoology at the London School of Tropical Medicine since 1914, in respect of the post held by him at the London School of Hygiene and Tropical Medicine. He has held the following posts:—Durning Lawrence Research Fellow, 1909, and Clinical and Pathological Research Fellow, 1913, Liverpool School of Tropical Medicine; Beit Memorial Fellowship, 1914; Protozoologist, Central Laboratory, Alexandria, 1915; Pathologist, 17th General Hospital.

The Degree of D.Sc. in botany has been conferred on Mr. Krishnadas Bagchee (Imperial College—Royal College of Science), for a thesis entitled "Cytology of the Ascomycetes. *Pustularia bolarioides* Ramsb. I. Spore Development."

THE Association of University Teachers announces in the June number of the *University Bulletin* the constitution of a Joint Standing Committee and inquiry office for promoting co-operation between university libraries. The inquiry officer is Mr. L. T. Oldaker, The Library, University, Edmund Street, Birmingham. Another interesting announcement which appears in the *Bulletin* is that the Council of University College, Reading, has decided, following the example set by Birmingham and already followed by Armstrong College, to form a standing Research Board to take responsibility for the promotion of research and the allocation of available funds. Evidence of the strength of the movement for promoting associations of university *alumni* and *alumnæ* is afforded by the announcement that the membership of the Leeds University Old Students' Association has increased since February 1924 from 500 to 1000.

THE Air Ministry announces that seven hundred aircraft apprentices, between the ages of fifteen and sixteen and a half years, are required by the Royal Air Force for entry to the Aircraft Apprentice School at Halton, Bucks, in January next. These apprentices, who must be well educated and physically fit, will be engaged as the result of two examinations: one an open competition conducted by the Civil Service Commissioners, and the other a limited competition carried out by the Air Ministry in conjunction with the local education authorities throughout the country. Since the aircraft apprentice scheme was inaugurated in 1920 approximately 2000 boys have completed their training and are now at work in service squadrons both at home and abroad, while approximately 3000 boys are now regularly undergoing training. Application to sit in the open competition must be made to the Secretary, Civil Service Commission, Burlington Gardens, W. 1, not later than September 3. Candidates for the limited examination should make application, if they are still at school, to their headmasters with the view of securing a nomination from the education authority responsible for the school. If they have left school, application should be made to the Advisory Committee for Juvenile Employment in their area. Applications must be received by the Air Ministry from nominating bodies by October 6. The syllabus for both examinations consists of mathematics, experimental science, English and a general paper. Copies of the regulations for entry (A.P. 134) can be obtained on application to the Secretary (M. 1), Air Ministry, Kingsway, W.C.2.

EDUCATIONAL research in America is greatly helped and stimulated by the publication by the Bureau of Education at short intervals of up-to-date bibliographies. We have just received a 30-page pamphlet giving some 500 references on higher education. There are no less than twenty references on the application of intelligence tests to candidates for admission to college and to undergraduates. In Columbia College intelligence tests have been used continuously since 1919 and have been found very useful. The Thorndike test of intelligence for high-school graduates has been found the best single criterion for admission to the college, and the Thorndike special intelligence test, used in the Columbia Law School, predicts success in the school better than the average college grade does. These and other similar data were published in an article by the assistant professor of educational research in Columbia University contributed to the March issue of *School Life*.

Early Science at Oxford

August 5, 1684 A Discourse of Sir William Petty's, concerning Land Carriages, was read

A Discourse concerning Digestion, and ye ferment of ye stomach, drawn up by Mr Lee of Brazennose College, was read, and will be printed in a little time

Some Seawater sweet'ned lately by Dr Plot, Mr Lee, and Mr Musgrave, was shewn ye Society, and judged to be not in ye least salt to ye tast, and fit for use

Dr Plot presented ye Society with some of ye *Pindes*, from ye Coast of Guinea, of which substance ye inhabitants make their bread, and severall meats, it seems to be a round seed He also comunicated some sawdust of a wood from Jamaica (ye name of which as yet wee know not) which being put into cold water did in some few minutes tinge the water of a delicate mulberry color

Dr Gibbons gave ye Society an account of a well near Cambden, ye water of which (as he is informed) tinges with galls a day or two, after it is taken from ye spring, then intermits for eight or ten days and after that tinges again he promises a more full account of this matter An Account of ye weather ye last month, taken (as usually) according to Dr Lister's scheme, was brought in by Dr Plot

The Society was informed, that Mr Lee of Brasenoze College has lately received a letter from a friend of his in Lanchashire, who lived severall years at Tangier, and assures him, that, during ye time of his stay there, he enquired into ye nature of ye current at ye Streights Mouth, by letting fall lines with weights at ye end of them, and that, which way soever ye upper Current went, ye lines were driven outwards, of which he sent this account to Mr Lee, takeing ye occasion from what he finds printed by Dr Smith in ye Transactions concerning this Subject, This matter will be farther enquired into, and (if possible) a relation of it be had under ye gentleman's hand

August 12, 1684 Ye Minutes of ye Dublin Society, from June ye 9th, to July ye 21st, 1684, being read distinctly, and considered, it was ordered that Mr Ash, and Mr Molineux be desired to impart their observations on ye last solar ecclipse, to be printed with those made at Greenwich, and Oxon

It is also desired, that Mr K— would be pleased to comunicate an account of his Mesolabe Ordered that Dr Pitt be desired at his leisure to draw up, and communicate to this Society, his thoughts concerning Digestion

Sr Wm Petty's paper of Land carriages, read ye last Meeting, enquiring into ye reason of ye Dishing of cart-wheels, Mr Walker was pleased to communicate these lines concerning it (*One* reason of ye Dishing of Cart-wheels seems to be this, when one wheel falls into a Hole, or deep cartrut, so that most of ye weight lyes upon it, then ye lower part of that wheel stands more perpendicularly to ye plain of ye Horizon, and consequently bears ye weight better than if ye wheel were plain, and not dish t)

A letter from Dr Turberville of Salisbury was read, it gave an account of ye three following cases

1 The *Bursa Oculi*, which was in ye white of ye eye, under ye upper lid, an empty purse, no matter in it, and hung flagg about ye length of a thumb nail

2 Another had no visible disease in his eyes but could not see at all without squeezing his nose with his fingers, or saddling it with narrow spectacles, and then he saw very well him ye Doctor carried to Mr Boyl 3 Another from Banbury, a Maid of 22 or 23 years old, could see very well, but no color, besides black and white She saw Scintillations by night, that much terrified her

Societies and Academies.

LONDON

Royal Anthropological Institute, June 9 —Shams-ul-ulama Dr Jivanji Jamshedji **Modi** The daily life of a Parsee of the seventeenth century, as described in the Persian Farziât-nâmeh of Dastur Darab Pâhlan The daily religious duties began with early rising at the crowing of the cock (a sacred bird, not to be killed for food, and even requiring a kind of sacred burial), followed by a recital on or very near, the bed, of Ashem Vohu, a sacred formula of prayer in praise of Asha (Sanskrit *rita*, English, right) This was followed by the application, on the exposed portions of the body, of *nirang* or *gaomiz* i e the urine of a cow (*gao*), held by the ancient Aryans as a purifying substance The application was followed by an ordinary ablution or, in special cases by a bath This was followed by a prayer, and there were five periods during the day for such obligatory prayers The ablution or bath was accompanied by the untying and re-tying of the *kusti*, or sacred thread, which a Parsee had always to put on on a sacred shirt, as symbols of his religion The ablutions with the requisite ritual were required after calls of nature and before meals, which began with the recital of grace A morsel was set apart for the dogs of the house or street, semi-sacred animals useful for various purposes For his daily diet meat may be used as little as possible, and, for that purpose, not healthy but weak animals were to be killed It was his duty to kill noxious creatures such as serpents, scorpions, mice, and the like All kinds of scepticism in religious matters were to be avoided A serious and solemn view of all daily actions had to be taken, and recitals of prayers for the blessing of God upon them were required The day ended with a recital of prayers

Linnean Society, June 11 —W **Bateson** Pelargoniums and the production of bud-sports Sports are probably due to the emergence of a distinct, previously existing component, originally formed by somatic segregation at an early stage Not very rarely the hidden component, perhaps most often a dominant, forms the central core of a periclinal system, emerging regularly in buds formed adventitiously on roots of inverted plants Not improbably the whole root belongs to the inner component Mosaic chimæras with islands showing a dominant also occur A growing point arising in such an island forms a periclinal with the dominant external The core on emergence is frequently still mosaic —F **Eyles** Remarks on the flora of Southern Rhodesia The type occupying a larger area than any other is the open forest, with trees widely spaced, not often exceeding 50 ft in height with a sparse undergrowth From the ecological point of view, water is the chief controlling factor the edaphic influence is also considerable, while temperature has less effect on distribution, owing to the relatively small degree of local and seasonal variation Rainfall occurs in two clearly defined seasons, namely, six months of wet season and six months of dry season, therefore all perennials must be adapted to face and survive six months of drought every year This necessity is met in the usual way —W **Garstang** On the origin of the crustacean carapace The cephalic shield is regarded as having arisen as a larval organ, in response to larval needs It is assumed that the proximate ancestors of Crustacea, prior to the development of a cephalic shield, were essentially trilobites of lower Cambrian type, and that the larvæ were discoidal and fitted only for

flotation Thus the so-called "typical" nauplii of Copepoda, etc, with powerful rowing antennæ, are less primitive than the discoidal small-limbed nauplii of Limnetis and Cirripedia On the development of post-cephalic segments, the trunk-rudiment sinks below the plane of the head, and the head repairs the breach in its suspensory disk by an outgrowth from behind This is claimed to have been the origin of the carapace—a larval adaptation to lengthen the pelagic phase Finally, on the larvæ sinking to the bottom, the carapace, as a result of its successive adaptations to pelagic conditions, was a structure big enough to be made use of for a variety of modes of adult life

Mineralogical Society, June 16 —A **Hutchinson** (1) The use of the stereographic protractor for the interpretation of Laue crystal photographs By a slight modification, the stereographic protractor previously designed by the author can be used for the interpretation of Laue photographs (2) The use of alignment charts in crystal optics The alignment charts in common use amongst engineers can be applied to the calculation of refractive indices measured on the total refractometer —H E **Buckley** and W S **Vernon** The crystal-structures of the sulphides of mercury The powder method of X-ray analysis showed that the precipitated black sulphide is cubic, with the symmetry of the natural metacinnabarite and with an arrangement of atoms like that of zinc blende, $a=5\ 85$ Å U, d (Hg-S) $=2\ 54$ Å U In cinnabar the arrangement of the mercury and sulphur atoms is a rocksalt one, slightly compressed along the trigonal axis and with a slight readjustment of atoms parallel to the basal plane, $a=4\ 16$ Å U, $c=9\ 54$ Å U, $c/a=2\ 291$ The type of movement in best agreement with the symmetry is D_3^4 In cubic mercuric sulphide each atom has four oppositely charged neighbours at a distance of 2 54 Å U, while in cinnabar two neighbouring atoms are situated at a distance of 2 54 Å U, as in the cubic mercuric sulphide, and two others at a distance of 2 91 Å U These facts indicate an eccentricity of the mercury atom if the sulphur atoms are regarded as spherical In cinnabar, in accordance with the circular polarisation sulphur atoms run down through the structure in trigonal spirals —Edmondson **Spencer** Albite and other authigenic minerals in limestone from Bengal The limestones of Cuddapah age near Raipura, Bengal, contain well-formed crystals of pure albite, apparently authigenic in origin The crystals are tabular on the brachy-pinakoid and are lozenge-shaped They are twinned on Carlsbad and albite laws similarly to those of the well-known Roc-tourne type but of different habit Accompanying the albite are phlogopite tourmaline, and quartz crystals, all believed to be authigenic Comparisons are instituted with similar occurrences of felspars in limestones from various European localities —Robert **Campbell** and J W **Lunn** Chlorophæite in the dolerites (tholeites) of Dalmahoy and Kaimes Hills, Edinburgh The dolerites of Dalmahoy and Kaimes Hills are exceptionally rich (up to 15 per cent or more) in chlorophæite, which occurs as a vesicle mineral, as veins, and as pseudomorphs after fayalite The mineral has a refractive index 1 498, hardness 1 5, and density 1 81, it has no cleavage and is isotropic It shows on exposure a striking colour change from bright olive-green to black, due to rapid oxidation From its physical and chemical characters the mineral is regarded as of a colloidal nature —L J **Spencer** Tenth list of new mineral names, with an index of authors

Royal Meteorological Society, June 17 —J E **Clark**, I D **Margary** and R **Marshall** Report on the phenological observations in the British Isles from December 1923 to November 1924 In this thirty-fourth report, 365 sets of records are discussed, compared with about 120 before 1922, the N W half of Ireland and most of West and North Scotland are still practically bare The year was described officially as "Dull and very wet with a very cloudy summer" Again it began mild, the four weeks to February 10 averaging 6° warmer than the succeeding four Sudden heat-bursts again raised false hopes, and made the records of plants, insects and birds again erratic Almost everything was much later than in 1923, and on the 30 years' average, flowers in the E and S E were one to two weeks late N England and Scotland still more Yet the hazel was early, blackthorn eleven days behind in S Britain, latest of all Insects, appearing later, ranged from 18 days late for the honey bee to three only for the Orange Tip, with the Meadow Brown in June a week early so too the migrants Vegetable growth was exceptionable, and little troubled by insect plagues, though slugs, snails and fungoid troubles were bad Tree fruit was scarce and of poor quality Grain and hay were saved with difficulty, potatoes were often diseased, but green crops and roots were some compensation —D N **Harrison** and G M B **Dobson** Measurements of the amount of ozone in the upper atmosphere Following the general method of Fahy and Buisson, the amount of ozone present in the atmosphere has been measured by spectroscopic means A marked connexion is found between the amount of ozone and the general pressure distribution at the surface, and a still closer connexion with the conditions at about 10 km —J **Baxendell** Meteorological periodicities of the order of a few years, and their local investigation, with special reference to the term of 5 1 years in Britain The following meteorological periodicities seem to be established 5 1, 3 1, 2 8, 2 4, 2 2, and 1 63 years Working on foreign and feebler English cycles, several of the shorter terms appear to be exact half-harmonics of certain of the longer ones, while there are also third-harmonic components The 5 1-year term was found at Southport in the 'eighties and has since been independently detected by five investigators elsewhere, two of whom have traced it back for three centuries It is especially pronounced in the frequency of the colder wind-directions, in Lancashire and at Greenwich but values for the term in rainfall, temperature, air pressure severe winters, and other data, are also given

Geological Society, June 24 —W J **Sollas** On a sagittal section of the skull of *Australopithecus africanus* Sagittal sections of the skulls of the anthropoid apes, the Hominidæ, and the Taungs skull, show that the last-named presents numerous and important characters, by which it differs from the anthropoids and makes some approach towards the Hominidæ The claims of Australopithecus to generic distinction are justified —D **Parkinson** The faunal succession in the Carboniferous Limestone and Bowland Shales at Clitheroe and Pendle Hill The rocks form that portion of the south-eastern limb of the Clitheroe anticline which is included between the Twiston and Clitheroe faults, along with most of the scarp-face of Pendle Hill The lowest beds appear to be of Z age, but the junction of Z and C is an uncertain horizon The knoll-limestones pass laterally into shales and crinoidal limestones The Worston Shale series is overlain by the *hodderense* goniatite-band which forms a constant feature along the foot of Pendle Hill The Pseudobilinque zone terminates below the Pendle Grit, where another goniatite (possibly *H leion*) appears, and forms a continuous horizon just below the grit It is suggested that the

base of the Upper Carboniferous should be drawn here The Worston shales appear to have been deposited on a very uneven sea-floor, the irregularities being due to the mode of accumulation of the limestones and not to interformational uplift and erosion —Miss J M M **Dingwall** Cyathoclisia a new genus of Carboniferous corals Certain Tournaisian corals of limited range, which are fairly abundant in certain localities in the south-west of England and South Wales, are described These forms agree with Clisiophyllum in their general features, but differ so markedly from the Visean species of the genus in structural details that it has been assigned the new generic name, Cyathoclisia, suggested by Dr W D Lang The members of this genus are simple rugose corals One species, *C tabernaculum*, shows remarkable variability, it appears to have a limited distribution, both horizontally and vertically So far as is known, it is confined to the south-western province of the Carboniferous Limestone Cyathoclisia may have been developed from Palæosmilia

PARIS

Academy of Sciences, June 29 —A **Lacroix** The meteorites of Tuan Tuc (June 30, 1921) and of Phu Hong (September 22, 1887) in Cochin China In the Tuan Tuc fall there were two meteorites found at a distance of 40 kilometres apart These were similar, being olivine and hypersthene chondrites The Phu Hong meteorite was a chondrite containing olivine and bronzite —H **Deslandres** Complementary researches on the structure and distribution of band spectra —G **Bigourdan** The topographical influences which affect the pendulum corrections employed at the B I H —A **Haller** and R **Cornubert** The constitution of dimethylcyclopentanone and of dimethylcyclohexanone in which alkyl groups have been introduced by the sodium amide method —Gabriel **Bertrand** and M **Mâchebœuf** The proportions of cobalt contained in the organs of animals Cobalt is found along with nickel in the organs of man and animals Numerous data are given, together with the methods adopted for the determinations The mode of distribution of the cobalt in the various organs is approximately parallel to that of nickel —Charles **Richet**, Eudoxie **Bachrach**, and Henry **Cardot** The hereditary fixation of acquired characters, proved by the stability of the displaced thermal optimum After cultivating the lactic ferment over a long period in a medium containing a large proportion of potassium chloride, a lactic bacillus is obtained possessing two new characters, resistance to potassium chloride is increased and the thermal optimum is strongly displaced in the direction of a higher temperature These acquired characters have proved to be stable —Rollet de **l'Isle** The method of elaboration and of publication of international scientific and technical vocabularies —R H **Germay** The periodic integrals infinitely near partial differential equations of the first order —Armand **Cahen** The continued fractions attached to operations about one unit above or below —Leon **Pomey** The determination of the integrals of differential equations by general initial conditions —J L **Walsh** The position of the roots of integral functions of genus one and zero —D **Menchoff** The summation of series of orthogonal functions —G **Fayet** and A **Schaumasse** The next return of Borrelly's periodic comet (1905 II = 1911 VIII = 1918) —Andre **Planiol** The calculation of the yield and heat balance of explosion motors —Louis **Breguet** The output from apparatus utilising the energy of the wind —G **Bouligand** An approximate method for studying the movement of certain vortex rings —A **Marcelin** Superficial solutions and the law of Gay-Lussac —Rene **Delaplace** The extension of the law of Gay-Lussac to superficial solutions —L **Riety** The electromotive force of filtration Aqueous solutions (1 per cent) of various iron salts, forced through a glass tube under a pressure of 25 atmospheres, gave rise to potential differences between $-0\ 070$ volt and $+0\ 21$ volt The results are discussed from the point of view of the rules given by Perrin The solubility of the glass and the hydrolysis of the salts employed influence the sign of the electric charge —E **Delcambre** and R **Bureau** The propagation of short (Hertzian) waves Details of the peculiarities noted for distances between 1500 and 10,000 kilometres in the propagation of short waves emitted by a transmitting station installed on the vessel *Jacques-Cartier* —A **Perot** and M **Collinet** The variation of the wave-length of the absorption lines of iodine with the density The same weight of iodine was placed in two tubes of the same diameter but of different length, both being heated in the same electric furnace to 180° C The variation of the wave-length was measured by a new interference method —Pierre **Daure** The determination of Avogadro s constant by means of the light diffused by ethyl chloride The value found was $N=(6\ 5 \pm 0\ 65)10^{23}$ —R de **Mallemann** The diffusion of light and Kerr's constant —L **Meunier** and Andre **Bonnet** The fluorescence of fisetine in Wood's light applications Certain bark extracts taken up on acetyl cellulose give a characteristic fluorescence in Wood s light The reaction has applications in analysis —J **Laissus** The cementation of iron alloys by chromium —R **Hugues** The annealing of electrolytic iron in a vacuum The iron was heated in an electric furnace specially designed to reduce leaks due to porosity Data are given showing the amount and composition of the gases evolved, and changes in magnetic and mechanical properties —Gerard H **Lafontaine** Contribution to the study of the equilibrium of magnesium carbonate in ammoniacal solutions —A P **Rollet** The solution of nickel in sulphuric acid under the influence of the alternating current —J **Errera** and Victor **Henri** The quantitative study of the ultra-violet absorption spectra of the dichlorethylenes The *trans* derivative absorbs more than the *cis*, and the difference increases for the shorter wave-lengths The absorption differences are the same in the pure liquids as in solution in hexane or in alcohol —L **Royer** The regular joining of crystals of different species —E **Rothe**, J **Lacoste** and Ch **Bois** Seismological observations made on the occasion of a violent explosion Advantage was taken of the detonation of 3250 kilograms of high explosive in a mine to carry out seismological observations with two types of apparatus, a seismograph of the Mainka type installed in a mine five kilometres from the place of the explosion, and a 19-ton pendulum recently set up in Strasbourg seismological station 142 kilometres from the explosion The latter instrument gave 2600 metres as the velocity of wave transmission —P **Lavialle** The nutrition of the embryonic sac in *Knautia arvensis* —Raoul **Combes** The migration of nitrogenous substances from the leaves to the stems in the course of autumn yellowing —F van **Gaver** Concerning the bony head and dentition of a young Asiatic elephant —Emile F **Terroine**, Mlle S **Troutmann** and R **Bonnet** The energy yield in the growth of micro-organisms as a function of the concentration of the nutritive substances of the medium and the food excess present —Mme L **Randoin**, J **Alquier**, Mlles **Asselin** and **Charles** The food equilibrium and relative proportions of mineral salts and glucides of a ration —L J **Henderson** The application of the nomographic method to the study of the

respiratory phenomena in the blood —**Caridroit** and **Pezard** The autonomous testicular growth in the interior of autoplastic ovarian grafts in the domestic fowl —S **Kostytschew** and A **Ryskaltchouk** The products of the fixation of atmospheric nitrogen by *Azobacter agile* The experiments lead to the conclusion that the Azobacter produces ammonia by the direct reduction of atmospheric nitrogen the ammonia is afterwards utilised for the synthesis of amino acids —A **Blanchetiere** The colour reactions of tryptophane with aldehydes —Raymond **Hamet** A new case of inversion of the effects of adrenaline —Rene **Fabre** and Mlle E **Parinaud** Study of the dissociation of the salts of narcotine and the best conditions for the extraction of this alkaloid in toxicology It is possible to extract with organic solvents the whole of the narcotine from solutions of its salts This is due to the marked dissociation of the salts in solution —**Vernadsky** The pressure of living matter in the biosphere —L **Fage** and R **Legendre** The swarms of a polychetal annelid (*Polyophthalmus pictus*) observed while fishing with a submerged light —Arthur **Grimberg** The treatment of external tuberculosis by a colloidal extract of Koch's bacilli Details of the treatment are given it has cured more than 50 per cent of the cases and improved the condition of a further 25 per cent —Et **Burnet** The differentiation of Paramelitensis by flocculation under the action of heat

CALCUTTA

Asiatic Society of Bengal, May 6 —C J **George** Root sucking aphids of Coimbatore —C **Chilton** The Amphipoda of Tale Sap This is an instalment of the "Zoological Results of a Tour in the Far East" Eleven species are examined Of these nine are the same as those from the Chilka Lake One species is described as new Two additional species from other localities are included in the report one, *Grandidierella gilesi* from Patani River a short distance to the south, on the same coast as Tale Sap, the other, *Colomastix pusella*, from Port Weld, on the other coast of the Peninsula —D N **Majumdar** The traditional origin of the Hos, together with a brief description of the chief Bongas (Gods) of the Hos —Hem Chandra **Das-Gupta** A few types of sedentary games prevalent in the Central Provinces The plays described are *atharaguhala teora, dash-guli, gol-ekuish, kaooa*, and *sat-gol*, and the description is based chiefly on the information gathered from a few villagers of Gosalpur, in the district of Jubbulpur —H **Chaudhuri** A study of a disease of garden peas (*Pisum sativum*) due to *Sclerotium rolfsii* The causal organism was isolated from the soil and the plant tissues Infection occurs through wounds only, and especially through wounds in the collars The fungus was grown in various media, the P_H value ranging between 5 and 7 8, range of temperature, between 10° C and 33° C Light is not an important factor in sclerotium formation, but dry atmosphere is favourable Perfect sterilisation was obtained by autoclaving soil in pots (30 lb for ten minutes) —Satya Churn **Law** Local names of some birds of the Manbhum District

SYDNEY

Linnean Society of New South Wales, March 25 (Jubilee Meeting) —R H **Cambage** (Presidential address) Need for a botanical and soil survey of New South Wales The growth and distribution of native plants are regulated by many factors, and therefore it is not possible to say definitely what a soil may produce without knowing all the facts governing its situation and accompanying conditions Subject to climate, the geological formation is a most important factor in regulating the growth and distribution of plants, and this is made manifest by the accordance in the changes of plant associations and of the rock formations For ages the native flora has investigated the chemistry and physical characters of the soil in Nature's laboratory, and the result is available for our study and our benefit in the indigenous vegetation which for so long has been allowed to work out its own destiny unmolested by invasions of either fresh fauna or flora Full advantage of the information at our disposal can be best achieved by a careful botanical and soil survey of our State so far as is reasonably possible —W F **Blakely** The Loranthaceæ of Australia Part VI Deals with 10 species and 8 varieties belonging to the subgenus Dendrophthæ, two old species are rehabilitated, and 1 species and 4 varieties are offered as new —G D **Osborne** Geology and petrography of the Clarencetown-Paterson District Part III A study of the main glacial beds at Seaham The total thickness of strata is measured at 1890 feet Some structures, produced by the dragging force of moving ice, are characteristic of glacial beds developed close to an ice-front, in contrast with the facies exhibited by glacial deposits laid down at a distance from the ice-front —Ida A **Brown** Notes on the occurrence of glendonites and glacial erratics in Upper Marine Beds at Ulladulla, N S W The glendonites occur in the Ulladulla mudstones, the lowest beds of a marine series, on a horizon which may be correlated with the Huskisson beds farther north They occur in mudstones closely associated with fossil beds, but have not been found in overlying mudstones which do not contain abundant fossils —A **Philpott** On a remarkable modification of the eighth abdominal segment in *Lindera tessalatella* Blanch, with a description of the male and female genitalia

VIENNA

Academy of Sciences, April 30 —F **Werner** New or little-known snakes in the State Museum of Natural History at Vienna Four new genera and eight new species of Colubridæ are included —C **Doelter** The effect of pitch-blende on mineral colours Radium produces effects in a few days, while pitch-blende requires some months —R **Kreman** and K **Zechner** On the influence of substitution in the components of binary solution equilibria (xlviii) The binary systems of azobenzol with acids (xlix) The binary systems of cinnamic aldehyde and salicylic aldehyde with phenols (l) Binary systems of acids and amines by R **Kreman**, G **Weber** and K **Zechner** —R **Kreman** and A **Hrasovec** Electrolytic conduction in molten metal alloys Attempts at repression of diffusion of metals in quicksilver by means of continuous current —G **Weissenberger** and F **Schuster** Organic molecular compounds (x) Vapour pressure curves (xi) Dolezalek's theory (xii) With H **Pamer** (xii) Chloracetic acids and penta-chlor-ethane —J **Zellner** Contributions to the comparative chemistry of plants (x) Chemistry of barks Elm, alder, walnut, plane-tree have been examined (xi) F **Stern** and J **Zellner** On *Sonchus arvensis* —W **Konrad** Time curves of the Tauern earthquake of November 28 1923

Official Publications Received

Scientific Papers of the Institute of Physical and Chemical Research No 28 On the Doublets and Triplets in the Spectra of different Elements By Yoshikatsu Sugiura Pp 31 35 sen No 29 Sur la toxicite du thiophène pour le nickel catalyseur et une autre action du cuivre catalyseur Par Bennosuke Kubota et Kiyoshi Yoshikawa Pp 33 50 20 sen No 30 A Classification of Enhanced Lines of various Elements By Masamichi Kimura and Gisaburo Nakamura Pp 51 69 +4 plates 45 sen No 31 Classification of Enhanced Lines of various Elements 2 Spectra of Intermittent Arc shunted by a Condenser By Masamichi Kimura Pp 71 79+1 plate 20 sen (Tokyo Komagome, Hongo)

NATURE

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Universities as Centres of Chemical Research

THE advancement of natural knowledge is the major, if not the exclusive, aim of all purely scientific societies, and to this aim they adhere as a rule very strictly In recent times, however, events have happened which have led to a wider view being taken of the functions of science, and hence we discern an increasing tendency for presidential addresses to wander from the narrower paths of esoteric learning and to linger awhile in the more spacious avenues that lead not only to increased knowledge, but also to improved social welfare Progress is determined by the interplay of many factors, intellectual as well as moral and physical, and leaders in the pursuit of new knowledge can do much towards its realisation if they possess their share of the tribal conscience and have the necessary courage to speak out

Of the many problems that touch both science and social welfare, that of research is one of the most fundamental, and in selecting this topic for his presidential address to the Chemical Society, as well as for his skill in handling it, Prof W P Wynne deserves our thanks and congratulations In this address [1] he reconsiders in the light of recent happenings the observations and conclusions expressed by Prof R Meldola when he spoke from the chair in 1907 In the opinion of the latter the output of research work was not "representative of the productive capacity of the nation," and the "enormous submergence of research talent" then existing was due mainly to the few openings offered by industry, the low salaries paid to junior university teachers, and to poverty compelling promising students to leave the university immediately after graduation The one bright spot in the somewhat dismal scene was the existence of scholarship schemes associated with the Royal Commissioners of the Exhibition of 1851, the Salters' Company and the Carnegie Trust, through which men of approved ability were enabled to carry on original work after finishing their college training

Prof Wynne's diagnosis of the present situation agrees in the main with that of his predecessor both indicate that lack of sufficient funds is responsible for most of our present-day defects and deficiencies In two tables Prof Wynne presents statistics relating to the output and distribution of chemical research in the British Isles during the three sexennial periods 1901–6, 1908–13, and 1919–24 The original chemical memoirs published in the leading chemical journals and in the Proceedings of the Royal Society, and emanating from higher educational institutions, numbered 865, 1271, and 1464 in the respective periods

[1] Journal of the Chemical Society, vol 127, April

To these totals the Universities of Oxford, Cambridge, and Manchester, together with the Imperial College (Royal College of Science and C T C), contributed, collectively, 33 8, 36 5, and 34 8 per cent, the London colleges, modern English universities, and Welsh, Scottish and Irish universities, 57 8, 53 2, and 56 1 per cent, whilst the technical colleges accounted for only 8 4, 10 3, and 9 1 per cent The persistent comparative sterility of the technical institutions is ascribed to the unenlightened outlook of the governing bodies concerned, and the approximate uniformity in the number of contributions from each of the three groups is regarded as accidental

Interesting as the detailed figures given in the printed address undoubtedly are, their significance must not be overestimated In the first place, it may be doubted whether numbers of papers published can afford an unambiguous index of research activity The criticism is often heard that modern workers are far too prone to publish small instalments (scraps !) of work at frequent intervals, rather than to wait until their investigations have attained a reasonable degree of completeness Publication of original research has become an almost indispensable condition of promotion in the academic sphere, and hence the young worker seeking notoriety and quick promotion may publish half-a-dozen small contributions in the same interval of time when a classical worker of the old school might have published only one Secondly, the statistical method used by Prof Wynne takes no cognizance of quality, and quantity without quality is of no greater moment in science than in art or morals Whilst, therefore, we may agree that Prof Wynne's figures warrant the conclusion that there has been a steady increase in the volume of chemical research—though not to the extent implied by the figures—there is nothing to indicate that there has been any corresponding increase in value The statistical method very often breaks down when applied to things of the spirit

In not repeating or endorsing his predecessor's opinion concerning the output of work being incommensurate with the productive capacity, Prof Wynne takes a wise course, because the question of productive capacity in the intellectual sphere must be very largely a matter of conjecture, and unless we have some fairly accurate means of measuring, it must be wrong to predicate any quantitative relationship between output and capacity to produce The belief may, however, be justified that, following the extension of educational facilities in our secondary schools, due to the enactment of the Fisher proposals, capacity for research is being increasingly developed, or rather, that those gifted with it are not being overlooked to the same extent as formerly Unfortunately, secondary education shares with university education the same handicap of lacking adequate financial resources, and therefore until better times arrive, both have to cut their coat strictly according to their cloth, compromise, and postpone enterprises of great pith and moment

Prof Wynne recalls that the university colleges passed their early lives in poverty, so that their administrators came to judge the success and the needs of departments by the number of students working in them, and to regard all departments as of equal value and importance, and these views still persist The relatively high cost of maintaining laboratories remains an added handicap to scientific departments, and it is suggested that in allocating grants, more consideration should be given to the number of post-graduates engaged in research, and to the number of hours actually spent in teaching Science demonstrators and assistants have to spend long hours in the laboratory, and therefore they should be given more free time for their own work Since, however, the universal call for economy rules out any increases in staff, it is of fundamental importance to inquire whether greater efficiency could not be secured by abandoning the present policy of allowing each university to attempt to excel in many branches of pure and applied science, and by substituting therefor more localisation and greater concentration of effort

For the old-established scholarship schemes for post-graduate research work Prof Wynne has nothing but praise, the figures he gives show that far more scholarships are awarded for chemistry than for any other science The Beit Memorial Fellowship and the Ramsay Memorial Fellowship Trusts have increased considerably the sums available for this work, whilst the Department of Scientific and Industrial Research, by giving maintenance grants for training in research methods, "has done a service to science and the country so great as to be almost incredible in the light of pre-War neglect" Its annual expenditure since 1920 in grants for research training in branches having industrial applications has been between 40,000*l* and 50,000*l*

The institution of the Ph D degree for research work was a war-time measure, originating in the desire to attract to our universities students from the Overseas Dominions and foreign countries who formerly would have studied in Germany It was recognised at the outset that success of the scheme for such a degree would depend mainly upon the expenditure of large public funds to improve the equipment of our laboratories and to provide increased amenities for the students, such expenditure has, unfortunately, not been found possible A serious blemish in the regulations for this degree is the non-provision of travelling scholarships for home students, as the

value to them of change of environment is very great. Since there is no immediate prospect that this defect will be remedied, Prof. Wynne suggests (1) that the Department of Scientific and Industrial Research should only renew its grants after the first year to students who migrate to another institution; (2) that the grants be renewable for a third year; and (3) that during the two years' absence from home the maintenance grant be increased.

Despite the acute and prolonged depression in trade, there has been a distinct change in outlook with regard to the employment of trained research chemists in industry, and for this the institution of research associations by the Department of Scientific and Industrial Research is largely responsible. Manufacturers, however, still complain of the inefficiency, from the works point of view, of the university-trained man; but, asks Prof. Wynne: Are the universities entirely to blame? What opportunities do industrial firms offer him for testing his vocation while there is yet time for him to make another choice? Is it not possible to allow selected students to spend some part of each long vacation in the works, not necessarily in the laboratory, but under foremen on the plant? The common objections relating to the violation of secrecy and interference with routine have been successfully overcome in Sheffield, where the presence of intending graduates is welcomed in the steel-works during the long vacation. There seems no valid reason why the example of Sheffield firms should not be followed in other centres and in other industries.

Finally, Prof. Wynne appeals to the Association of British Chemical Manufacturers to assist and co-operate with the universities in such matters. He recalls the fact that the Chemical Society took a leading part in launching the Association, but he did not mention, as he might have done, that the conferences of the chemical societies which led to its foundation were convened to consider the best methods, not only for promoting co-operation among chemical manufacturers, but also co-operation "between them and the teachers in universities, colleges, and technical schools." The Association has admittedly done good work for the manufacturers, and in support of Prof. Wynne we venture to express the hope that it will add to its laurels by working with and assisting institutions of higher education. As Prof. Wynne says, "University and industry—theory and practice—obviously must collaborate if the chemical industry of this country is to make headway in face of present difficulties"; indeed, without the co-operation of the universities, the industry can neither hope to prosper in times of acute international competition, nor fulfil its patriotic obligations in times of international strife.

National Art in the Stone Age.

Urgeschichte der bildenden Kunst in Europa, von den Anfängen bis um 500 vor Christi. Von Moritz Hoernes. Dritte Auflage, durchgesehen und ergänzt von Oswald Menghin. Pp. xix + 864. (Wien: Kunstverlag Anton Schroll und Co., 1925.) 30 gold marks.

ALTHOUGH written history begins in Europe two thousand years later than in Egypt or Mesopotamia, the archæological record is nowhere longer or more continuous. Art is more the object of the archæologist than the philologist; and in this domain Europe is exceptionally rich. The men of the Old Stone Age decorated bones or cave walls with marvellous drawings which recall to life an extinct fauna. But the naturalism of palæolithic art passed away with the advent of more modern climatic conditions; in France and Spain, the centres of quaternary art, only conventionalised and æsthetically worthless survivals are to be found on the walls of Copper Age cave-shelters and dolmens. Only in the extreme north did a naturalistic art, stylistically if not genetically akin to that of the cave-men, persist throughout the New Stone Age among backward food-gathering tribes. From that period, which saw the establishment of food-producing economy, no artistic products have elsewhere come down to us save geometrically decorated vases and rude clay figurines.

The same geometric character pervades continental art in the Bronze and early Iron Ages. But in the Ægean in the seventeenth century B.C., a new and deliberate naturalism arose under the shadows of the Cretan palaces, only to fall a prey to conventionalism and eventually to become geometric in the "Greek Middle Ages," as Hoernes happily describes the Late Mycenæan and Dipylon periods. The final revival of naturalism begins in the city-states of archaic Greece, and Etruria, then among the Celts of La Tène, and finally among the Teutons in the first centuries of our era. Hoernes saw in these transformations the reflection, not of racial, but of economic and social changes. The primitive naturalism was proper to the parasitic life of hunters. Geometric styles correspond to the symbiotic economy of peasants, and in the permanence of their designs betray the prominent part played by women in the new industries. A synthesis of the foregoing moments in a class-society wherein a "parasitic" layer of rulers, priests, and warriors has been superimposed upon the peasantry evokes the conscious naturalism of Middle Minoan Crete or La Tène. With these masterly generalisations the Viennese professor summed up abstractly the artistic evolution of our continent.

In presenting the evidence on which these conclusions

were based, Hoernes adopted an almost equally abstract method Writing in 1914, he did not believe in the possibility of identifying racial groups by archæological data In the ten years since his death, the immense progress of science has left the prehistorian no alternative but to adopt the concrete methods of the historian His characters are indeed nameless and the individual still eludes him, for in the epoch with which he deals the individual was still merged in the collectivity Prehistoric art is like modern peasant art, it is far more the product of the group, the embodiment of its æsthetic traditions, than the creation of an individual artist On the other hand, just as peasant art in Brittany is distinct from that of the Ukraine, so the several styles of geometric decoration on neolithic pottery must be regarded as embodying the ideals of specific racial groups Hoernes' pupil and successor, Prof Menghin, is animated by this principle throughout the two hundred pages of his appendix Thus even in the Old Stone Age the "impressionist" scenes painted on the rocks of southern Spain may be contrasted with the isolated realistic figures depicted farther north This contrast illustrates the distinction between a race newly come from Africa (the Capsians) and more Eurasiatic stocks

In the New Stone Age the archæological map of Europe discloses a veritable mosaic of cultural groups The sharpness with which these nameless peoples stand out, the precision with which their migrations can often be plotted, will come as revelations to English readers Pottery is now the best guide to their identification and the principal vehicle for their artistic self-expression Thanks to Prof Menghin, we now have for the first time a complete and reasoned account of the ceramic styles and their interrelations The loess-lands of the Danube valley are occupied by peaceful peasants Fine pottery adorned with spirals and mæanders defines the extent of their colonies, derivative types growing into local styles mark their gradual expansion to Poland, south Germany, and Belgium From the west (probably from Spain, for brachycephals are found there despite Menghin's statement to the contrary) a short-headed race of armed traders introduce their bell-shaped beakers into central Europe there mingle with a Nordic tribe, and eventually invade Britain But the real plot of European prehistory is the victorious expansion of the "Nordic culture" The latter, Menghin frankly attributes to Indo-Germans (*i e* Indo-Europeans or Aryans), for he is a Germanist albeit a temperate exponent of theories often travestied by too ardent advocates The submergence or absorption of the Danubian peasant art by that of Nordic invaders is in any case patent It provides a truly historical explanation for that contrast between peripheral and tectonic styles of decoration upon which Hoernes based his whole treatment of neolithic pottery, for the metopic division of the vase-surface was as characteristic of the North as the free ornament was of the Danube valley

Here, as in the analysis of west European cultures, the concentration on ceramic evidence imposed by the plan of Hoernes' work tends to hide difficulties The internal incoherence of the "Nordic culture," notably the opposition between the separate-grave folk of inner Jutland and the megalith-builders on the Danish coasts, would have become more glaring had weapons and ornaments been considered Conversely, chronological difficulties have been evaded by giving the "Caucasian pottery" the status of an independent group It can, however, only rank among the subdivisions of Menghin's Nordic group, direct genetic relationship is demonstrated *inter alia* by the very peculiar type of tomb in which similar vases occur both on the Saale and on the Kuban (Menghin's printer has consistently confused this river with the Iron Age site of Koban) If the high antiquity of the latter tomb really precludes its attribution to a clan hailing from central Germany, the only alternative is to invert the direction of the journey

If, however, the warlike Nordics must claim the attention of the historian, they have little to offer to the artist On the other hand, the peaceful peasants of the south-east have left us monuments of real beauty —magnificent painted vases The Thessalian group is already familiar, this well-illustrated account of the Transylvanian-Ukrainian vases and figurines will be all the more welcome We would, however, suggest certain corrections The most important site yet excavated—Erosd—is omitted Now the inhabitants of this Copper Age village, nestling among the mountains of Transylvania—the ancient El Dorado of central Europe—not only decorated their vessels with polychrome spirals and mæanders but also adorned the walls of their substantial houses with frescoes and plaster mouldings Then pottery virtually identical in technique and decoration with that of Erosd appears intrusively in a corner of Thessaly How can Menghin deny that this intrusion marked an invasion from beyond the Balkans? In Thessaly this genuine painted fabric gives place to the curious "crusted" ware on which the colours are applied only after the burnishing and firing of the vase The same technique is encountered in the Danube valley from Serbia to Moravia But Hoernes and Menghin have not distinguished it from true painting, and so have missed the essential cultural continuity between Thessaly and the Danube valley at this period In fact they treat the Danubian crusted ware as older than and partly the ancestor of

the painted pottery of Transylvania, whereas the stratigraphical sequence in Thessaly would suggest just the opposite relation Finally, the curious way in which stylised animals come to figure among the geometric designs of the latest painted pottery in Galicia and the Ukraine is surely a phenomenon worthy of note in a history of art However, the painted pottery appears with meteoric brilliance only to vanish utterly in the night Perhaps the vase-painters were submerged by the same Nordic flood that had overwhelmed the peasants of the Danube valley

The remaining ceramic groups distinguished by Menghin are of less artistic or historical significance He finds no continuation for the mesolithic wares of the Danish kitchen-middens and Campigny and, with less justification, isolates the neolithic pottery of Crete from its successors and neighbours The artistic capabilities of the rude hunters of the extreme north are better expressed in their carvings than in their coarse vases Finally, all the wares of western Europe and north Africa are classed together in one admittedly amorphous group Incidentally, while flattered by the prominence accorded to English neolithic wares in the last-named group, we deplore the neglect of the richer Scottish material

As a whole, this book with its 1462 illustrations constitutes a veritable corpus of neolithic pottery, and the art of the later periods and of the Ægean is treated with no less thoroughness and lucidity If there be room for differences of opinion on isolated points as indicated above, that is but natural in a pioneer work on a young science, no such detailed or comprehensive survey of European prehistory has ever before been attempted in any language

V GORDON CHILDE

The Study of Corals

An Introduction to the Study of Recent Corals By Prof Sydney J Hickson (Publications of the University of Manchester, Biological Series, No 4) Pp xiv+257 (Manchester At the University Press, London Longmans, Green and Co, 1924) 25*s* net

AMONG living zoologists no one is more competent than Prof Hickson to write a book on corals Many years ago he made acquaintance with coral organisms in their natural surroundings, and since then the Anthozoa, the group to which most corals belong, have been one of the chief objects of his study Those, therefore, who already know his lucid and attractive manner of writing will be prepared to expect an authoritative and fascinating work, and they will not be disappointed But first one or two small criticisms

The author's definition of the word "coral" will probably excite surprise by its breadth He uses it for marine sedentary organisms, animal and vegetable, "that produce a solid skeletal (or more accurately *shell*) structure of calcium carbonate which persists as such entire, after the death of the living organisms that produced it" The things included in the term corals are therefore the calcareous marine plants, certain Foraminifera and sponges, the madreporarian corals, certain Alcyonaria (such as the precious coral) and Hydrozoa, and also some genera belonging to the Polyzoa and Annelida But has the term coral ever been used, even popularly, in such a wide sense as this? In practice Prof Hickson widens it still further by including Gorgonia and the antipatharians, the skeleton of which is not calcareous at all Parenthetically, would the skeleton of the precious coral ordinarily be termed a shell structure, and is it "strictly speaking, an outside support or exoskeleton" (p 17)?

We shall not quarrel very seriously, however, with the definition proposed by the author He has had the happy idea of describing for us, in an easy and delightful fashion, a number of organisms which have interested him, and of illustrating his descriptions by choice examples of the photographer's art He is in want of a term under which these can be subsumed, and "coral" is at least not altogether inappropriate—is as suitable, at any rate, as any single word can be

One other objection to the author's use of terms We shall not all agree that "the conception of individuality has no relation to the structure or function of the parts but to the discontinuity of the living organism as a whole from other living organisms", though it may perhaps be true that "the Alcyonium or the Tubipora as a whole is, *in common language* (italics the reviewer's), the individual, and the polyps parts or organs of the individual"

Coming to the contents of the volume, the introductory chapter, "On the Use of some Words," deals with the meaning of "coral" and "individual," which we have just alluded to, to that of "polyp" (which Prof Hickson extends to the zooids of the Polyzoa) and "zoophyte" Chap ii gives a short account of structure, especially of that of an anthozoan polyp, and classification, to it is appended an interesting "Additional Note on the Nutrition of Corals," discussing the part played by symbiotic algæ Chaps iii and iv (pp 23-102) deal with madreporarian corals, this, the backbone of the subject, is attractively treated in a simple style and in clear language, made even clearer by diagrams and by exquisite reproductions of photographs (we dare not, in this journal, imitate Prof Hickson (p 190) and write photos) of the actual objects It is confusing and contradictory, however, to state,

of the mesenteric muscular bands, that " in the cases of the directive mesenteries these ridges are on the surfaces *opposed to each other* (italics the reviewer's), that is to say, they face outwards " (p 33) The interesting association of Heterocyathus with the gephyrean Aspidosiphon is described on pp 39-40

Alcyonarian corals are described in Chap v , Corallium, Tubipora, Heliopora and Gorgonia are treated at some length, a number of other genera more cursorily Chap vi disposes of the antipatharians in a few pages , and successive chapters are given to the hydrozoan corals—Millepora and the Stylasterina, polyzoan corals , foraminiferan and poriferan (Merlia) corals and annelid worm tubes , and lastly coral Algæ—the red seaweed corals and green seaweed corals

The penultimate chapter is something of a disappointment We feel that in a volume on corals by Prof Hickson we had a right to expect more than 17 pages on coral reefs , we would willingly have sacrificed the worm tubes, sponges, and Foraminifera, as well as the Algæ, to have had an equivalent here The author's very first words—the opening sentences of the preface—speak of the fascination, the charm, and the enduring interest of the life of the reefs , but he gives us little more than a brief account of the composition and form of the reefs, and of the theories of their formation

The last chapter gives an agreeable account of the trade in black and red coral from the earliest times Among much other interesting information we are told that some years ago a great bronze shield, supposed to belong to the Early Iron age, was found in the bed of the river Witham in Lincolnshire, bearing five large pieces of red coral, each circular in outline, ground to form a convex surface and polished , and that armour decorated in a similar way has also been found in Ireland Even in the eighteenth century red coral was much esteemed as a drug, being given, for example, in a paste along with crabs' eyes and other things, for fevers in children

The book is obviously intended to be of use to the intelligent layman, who has only the most elementary acquaintance with physiology and anatomy But it will certainly be read largely by others , not only by elementary but also by advanced and honours students of zoology who are making a special study of the Anthozoa For these, as well as for zoological amateurs, it will be a delightful occupation to go round the cases of the Manchester Museum, or of the British Museum, with Prof Hickson's book in hand We congratulate the author on his accomplishment , would that all zoologists, before the conclusion of their active life, would give us similar accounts of the groups which have formed the subject of their researches

Morphology of the Alimentary Canal

Vorlesungen uber vergleichende Anatomie Von Prof Otto Butschli Lieferung 4 Ernahrungsorgane Herausgegeben von F Blochmann and C Hamburger Pp iv+380 (Berlin Julius Springer, 1924) 6 45 dollars

THIS is a compilation of a kind which we expect from the patient industry and passion for orderly arrangement of the German scientific writer It is a mine of information from which details of the structure of the alimentary canal of a very large number of animals can be extracted with a minimum of trouble To the English zoologist it will appeal most because it is illustrated with the thoroughness which the German author rightly believes to be necessary, and the illustrations are selected with characteristic care A large proportion of them are entirely new to text-books, and many of them are from original drawings of Butschli But for the fact that they are sometimes rather too small to be easily understood, they are really excellent and a substantial justification for the publication of the book

When we consider the text, however, there arises the question as to how far a morphological encyclopædia of this kind is valuable to zoologists It has, indeed, occurred to the authors that a certain amount of physiological information should be incorporated into their work This is, however, relegated to paragraphs of small print for the most part and, even making allowance for the scantiness of present-day knowledge, is insufficient The alimentary canal lends itself less to purely morphological comparisons than any other system of the body It is so plastic that astonishing differences may exist between closely related animals which are obviously related to differences in diet To take an example, the excellent morphological account of the alimentary canal of the Mollusca seems incomplete to the reviewer because the varied habits and physiological characters of such forms as nudibranchs, heteropods, boring lamellibranchs, and many others are never mentioned The initiated may be able to fill up the gaps, but there is not much help for the student who wants to know how much of the form is related to function Nor is there usually more than casual reference to the histology of the various alimentary organs This is no doubt outside the scope of the work, but it may well be claimed that, in the study of the alimentary system, histology is as indissolubly connected with gross anatomy as physiology

It is surprising to find that there is practically no introduction and no general summary, which is surely needed here The fact is that treatises on comparative

morphology and comparative physiology as well (like the stupendous Winterstein) do everything but compare They present an array of densely marshalled facts through which the reader travels despairingly, being quite unable to see the wood for the trees

Pottery and Porcelain

Pottery being a Simple Account of the History of Pottery and a Description of some of the Processes employed in its Manufacture (Pitman's Common Commodities and Industries) By Charles J Noke and Harold J Plant Pp xi+136 (London Sir Isaac Pitman and Sons, Ltd) 3*s* net

Pottery and Porcelain a Handbook for Collectors Translated from the Danish of Emil Hannover Edited with Notes and Appendices by Bernard Rackham Vol 1 Europe and the Near East Earthenware and Stoneware Pp 589+7 plates (25*s* net) Vol 2 The Far East Pp 287+2 plates (18*s* net) Vol 3 European Porcelain Pp 571+2 plates (25*s* net) (London Ernest Benn, Ltd, 1925)

THE first-mentioned of these works might, happily, serve as an introduction and technical aid to the important and comprehensive handbook with which it is associated in this notice Its authors have accomplished their modest scheme with such ability and success as to give the reader who is not a potter an insight into the practical methods which are followed in the manufacture of the multifarious articles of pottery and porcelain, whether intended for everyday use or as the embodiment of precious artistry, which men treasure in our day even as they seem to have prized and collected such things for unnumbered years The clarity and simplicity with which the technical information is presented—together with excellent illustrations and photographic reproductions of the tools, methods, and processes used by the Staffordshire potters of our time—deserve warm commendation Apart from the immediate aim of the writers, which has been to aid the student-workman who is engaged in the craft, every collector of pottery and porcelain who wishes to acquire clear ideas of how the precious objects he treasures were made will find this a handy and reliable little work of reference, to be used in conjunction with those voluminous histories of the potters' achievements in which technical matters are not always treated with such simplicity and precision

The scholarly and comprehensive handbook for collectors compiled by the late Dr Emil Hannover and here translated for English readers by Mr Bernard Rackham, one of our foremost museum authorities—who also contributes greatly to the value of this English edition by an extensive series of explanatory notes and addenda—displays at once the strength as well as the weakness of any survey, aiming at completeness, of such an extensive field by any single author Undoubtedly, Dr Hannover's narrative gains in unity of purpose and of outlook because all the ideas have been distilled through the alembic of a single, well-informed mind It is, however, almost inevitable that certain sections of any work that proposes to set forth the complete history of an artistic craft that is coeval with civilisation, which must therefore comprehend all the fictile arts of the Greek, Persian, Chinese, Japanese, and European peoples—to mention only the more important—should be less satisfactory in judgment and understanding than others Having entered this modest *caveat,* the reviewer is free to appreciate the fare so abundantly set forth for the reader's delectation and instruction

It is only possible in the space at our disposal to direct attention to the more salient features of the work, for as a comprehensive bibliography of ceramic literature is included, the reader who requires fuller information on any specific point will readily find the most authoritative sources to which he may turn for further enlightenment Another feature, which adds to the completeness of the work and its consequent value to collectors, especially to those who have but recently acquired that delightful hobby, is the valuable descriptive notes and illustrations of "forgeries", for though, as Dr Hannover says, "the really dangerous counterfeits can only be distinguished by acquiring a thorough knowledge of the genuine things," it is possible to prepare one's self for meeting the spurious thing and its recognisable defects

It seems but natural that one should instinctively turn to the volume which deals with the ceramic productions of the Far East, especially as for the last two centuries these Oriental wares have exercised such a powerful influence on all European pottery and porcelain, with the exception of the stonewares In the few years that have elapsed since the close of the War, all competent observers must have been impressed with the number of artist-potters, working on their own account or in association with old-established factories, in all European countries, who have turned with a fresh, often a childlike eye to the older treasures of Chinese and Japanese skill and are now exhibiting their pleasure by the production of works which, though frankly European in style, are not ashamed to acknowledge the sources of their technical inspiration

In the same way, Dr Hannover, having absorbed all that has been written by the foremost authorities, gives us a condensed but eminently readable account of the growth and development of the ceramic arts in

the Far East in his second volume As to the spirit in which he entered into his work, one cannot do better than quote a short section from his summary of the position of the art in China at the end of the fourteenth century

"For if a piece of five-coloured Ming or of K'ang Hsi blue-and-white often appeals with greater sweetness to the senses than almost any other fruit of human craft and genius, it is due to the fact that the object itself, by virtue of a continuity hardly conceivable in any but the most conservative country in the world, is the product, ripened with infinite slowness and infinite sureness, of traditions more than a thousand years old It is to the oldest pottery, here briefly described, that we owe this tremendous acknowledgement"

The reader will turn to Vol I, which treats of the earthenwares and stonewares of Europe and the Near East, with the assurance that the author, from his position as Director of the famous Museum of Industrial Art at Copenhagen, will have a first-hand acquaintance with the work of the European factories, particularly with those of the northern and eastern countries, of which British museums can scarcely be said to contain thoroughly representative collections As Mr Rackham notes in his "foreword,"

"The sections in Vols I and III relating to the potteries of the Scandinavian region, although treated on a somewhat fuller scale than the remainder of the book, have been allowed to stand unshortened No full accounts of the Northern wares have ever been published in English, much even of the author's work in this section of the book embodies entirely new research which had never before been published in any language It seemed therefore essential that his valuable contribution to ceramic history should be given in full to the English reader"

All of which is very handsome of Mr Rackham, especially as Dr Hannover treats our British pottery in very summary fashion, and expresses in round terms an idea that I have often heard from keepers of Continental museums when he writes

"for, as we have many times noted, when speaking of conditions on the Continent, it was English earthenware in the classical and insinuating form given to it especially by Wedgwood and Leeds that was the doom of the old faience And not of faience only—this great English industry put an end to the development through more than two thousand years of *all* the ceramic arts, porcelain not excepted"

The volumes are profusely illustrated with half-tone plates, generally of admirable clearness, and, in addition, there are a few coloured plates of great beauty Such plates as that of the Marieberg Tureen (Plate VII, Vol I) will be new to the majority of English collectors

WILLIAM BURTON

Ubique

The Roll of Honour of the Institution of Electrical Engineers Pp xv+330+40 plates+6 maps (London The Institution of Electrical Engineers, 1924)

THIS very handsome volume contains biographical notices of the 162 members of the Institution of Electrical Engineers who lost their lives in the War, 1914–1919

The extremely able summary of the origin and causes of the War, as well as all the biographical notices, have been written by Bt-Lieut-Colonel W A J O'Meara, C M G, (late) R E, and his task, which took him no less than five years to accomplish, has been performed in a truly admirable way All the notices give details of the particular member's life prior to the outbreak of War, followed by a comprehensive and sympathetic summary of his service in the field Further, in all cases, every action mentioned is linked up with the actual operations that were in progress at the time, so that a true perspective is maintained and continuous interest is ensured Nearly every notice is accompanied by a well-reproduced portrait, and in a pocket at the end are placed six excellent maps of the various theatres of War, on which the operations can be readily followed

On analysing the services of these 162 members, it is seen that in August 1914 only five belonged to the old regular fighting Services, one each to the R N, R A F, and R A, and two to the R E Of the others, one cannot fail to be struck by the fact that, despite their specialised engineering education, the Royal Engineers did not claim more than 40 of them The remainder were allowed to join almost every branch of the Service, and they are found in the Royal Navy, yeomanry, artillery, infantry, and Air Service, with trench mortars, in the Machine-Gun Corps, in the Army Ordnance Department, Army Service Corps, Friends' Ambulance Unit, on the Embarkation Staff, in the Indian Defence Force, and with the Expeditionary Forces from Canada, Australia, New Zealand, and South Africa They performed technical duties in the Anti-Submarine Division, with searchlights, and in sound ranging Nevertheless, in reading their biographies, it is impossible not to recognise the fact that in whatever branch these men served, their knowledge of engineering was always valuable, and they were able to make use of it in many ways, both for the assistance of their own unit and in furtherance of whatever operations were being undertaken

To take a few instances One member, a student of 1912, Lieut (later A/Major) D G Trouton, belonged to the R F A (Special Reserve) at the outbreak of War, and he was at once posted to the 2nd Divisional

Ammunition Column, and with it proceeded to France in August 1914 He served throughout the retreat from Mons and subsequent advance to the Aisne, and he was seriously wounded during the battles of Ypres 1914 Later, he served through the Suvla operations with the 11th Division, until he was invalided with dysentery in November 1915 Rejoining in France, he took part in the battles of the Somme 1916, and was again seriously wounded Returning again to France before the close of the year's fighting, he was in the battle of the Ancre Heights In 1917 he was engaged in the battle of Messines and then in the battles of Ypres 1917 Shortly after promotion to A/Major, he was killed in his battery position in the first battle of Passchendaele on the day before his twenty-fourth birthday He well deserves the stirring pages devoted to his long war record and gallant services

The spirit shown by members of the Institution on the outbreak of hostilities is well illustrated by the case of Rifleman A T Mahon A student in 1913, he at once offered his services Rejected on chest measurement, he underwent a course of physical exercises and offered himself every month until he was finally accepted in February 1915 He then joined the 5/London Regiment (London Rifle Brigade) He went to France in August, and in due course joined the signal section of his battalion His division (56th) took part on July 1, 1916, in the ill-fated attack on Gommecourt At the height of the fighting, his battalion being isolated and ammunition running low, the signallers were ordered to establish communication by wire with the troops To carry out this task Mahon and a comrade, taking their instruments, at once went forward to what was almost certain death That night Mahon was reported missing, and afterwards he was presumed to have been killed Devotion to duty of this nature is sometimes awarded a very high distinction, but Mahon's gallantry remains its own reward It must have given Col O'Meara a melancholy satisfaction to save this fine deed from oblivion

The Dominions, too, are well represented in this Roll of Honour Lieut (Hon Capt) A T Hayne, D S O, D F C, who was born and educated in South Africa, had come to England in 1913 to take a four years' course in electrical engineering By the time the War broke out he had already acquired a thorough knowledge of internal combustion engines, which proved invaluable to him later on He joined up in January 1915, and after serving in the autumn at Helles with the armoured cars, he transferred in 1916 to the R N A S, and went to France in January 1917 In this theatre he performed splendid service, for he had to his own credit twenty enemy machines brought down in single combat, and in one set of operations he carried out no less than forty-eight special missions Unfortunately, in April 1919 a machine that he was testing crashed and he was killed instantaneously

Another overseas member, Major H C Symmes, was born in Canada He took the five years' course in mechanical and electrical engineering at McGill University Later he joined the Canadian contingent and went with it to the Boer War After the contingent returned, Symmes remained behind in Pretoria working on the staff of the Transvaal railways, and in 1911 he became Inspector of Machinery and Electricity in the Mines Department He at once volunteered for service on the outbreak of War, and, in command of a company of the Witwatersrand Rifles, he served in the campaign in German South-West Africa He then proceeded to Europe with the South African Brigade, and in July 1916 he took a reinforcing draft to France In October 1916 he participated in the heavy fighting for the Butte de Warlencourt, in which operations the South African Brigade lost 45 officers and 1150 other ranks Major Symmes was killed on the first day of the battles of Arras 1917, whilst gallantly leading his men

Our allies also furnish three members in this Roll of Honour Belgium is represented by Caporal W R E Claeys, and France by Sergent J H Labour, and l'Inspecteur-General G P Seligmann-Lui, Director-General of Telegraphs and Telephones at G Q G, and all three have most distinguished civil and military records

A copy of this Roll of Honour has been sent to each member's next of kin, and the Institution is indeed to be congratulated on the form of memorial it has chosen, with the idea of perpetuating the names of its members who died in the War and ensuring that their services shall live for evermore Men who came from the ends of the earth to fight for their country, who placed patriotism before mere private profit, using their engineering skill and finally giving their lives for the cause, "the wide earth is their sepulchre"

Fatigue and other Properties of Metals

(1) *The Fatigue of Metals* By H J Gough Pp xx+304+14 plates (London Scott, Greenwood and Son, 1924) 25*s* net

(2) *Grundbegriffe der mechanischen Technologie der Metalle* Von Dr Georg Sachs (Die metallische Werkstoff Gewinnung, Behandlung, Veredlung Band 2) Pp x+319 (Leipzig Akademische Verlagsgesellschaft m b H, 1925) 13 gold marks

(1) MR H J GOUGH, a member of the staff in the Engineering Department of the National Physical Laboratory, has written a book on a subject to which he has himself made valuable original

contributions This in itself gives it unusual value, for he writes with first-hand knowledge and authority The title itself needs some explanation The phrase "fatigue of metals" has long been used by engineers to denote phenomena leading up to the failure of metals under repeated stresses The original underlying idea was that, under these conditions, the metal gradually became "crystalline," and that this was the primary cause of its breakdown Modern research, however, on the crystalline structure of metals has shown that this is not the case, that no crystallisation occurs, but that the failure takes place because the metal ultimately breaks on a comparatively few planes which, on account of their size, give the appearance of crystallinity As the author points out, the term is far from ideal, being both indefinite and rather misleading He tells us that "our ideas of fatigue phenomena must frankly be admitted to be in the melting pot," and that "no research yet published has been sufficiently fundamental" to characterise satisfactorily this phenomenon

In spite of this, however, Mr Gough uses the term because it is so widely employed, but he defines it quite generally as "the behaviour of metals when subjected to repeated stresses" Examples of this are numerous, and include the axles of railway carriages and trams, crank shafts and connecting rods of reciprocating engines, hulls of steam-ships, motor-car springs and chassis, railway rails and tyres, shafts of steam turbines, teeth of pinions, valve springs, and many machine details

The subject is of supreme importance on account of the present-day tendency to employ high working stresses and speeds in the design of machines and prime movers Dr Stanton, who contributes a foreword to the volume, remarks that Rankine clearly anticipated in many ways the results of research in this field, and that since the publication of Wohler's experiments in 1860–70, investigation has proceeded in two main directions On one hand, methods of determining the fatigue range of stress on material under given conditions have been so much expedited that the whole determination is now only a matter of an hour or two, accordingly, this has brought the fatigue test within the scope of standard tests of materials Twenty years ago it took so long to perform that it would have been quite impossible to include it in any specification On the other hand, attempts to try to understand fatigue phenomena have resulted in important contributions being made to our knowledge of the crystalline structure of metals Mr Gough's contributions have been in both these fields His book is the first attempt which has been made in Great Britain to study the subject as a whole, and he has performed a valuable service in bringing within its scope a careful consideration of the experimental data published in many journals Among the subjects dealt with in its ten chapters are repeated-stress testing machines, endurance limits of metals, elasticity and its relation to fatigue, the fracture of metals under statical and repeated stresses, theories of fatigue failure and methods of rapidly determining fatigue ranges It deserves to be widely studied by engineers and metallurgists

(2) Not unrelated to the previous work is that by Dr Georg Sachs on "The Mechanical Technology of Metals" This also is a book written by an engineer, a member of the staff in the Kaiser-Wilhelm-Institut fur Metallforschung The first section is concerned with the mechanical behaviour of solid metals, especially with reference to elastic properties, changes of form, tensile, compression, and torsion tests, cohesion and hardness Then follows a consideration of metallic crystals and their properties Upwards of twenty pages are devoted to the special properties of single metallic crystals These are contrasted with the properties of crystalline aggregates in the following section The author states that in their elastic behaviour, single crystals are sharply differentiated from crystal aggregates in that they are free from hysteresis, and in support of this quotes the work of Wartemberg and Geiss on the crystals of tungsten and zinc Later sections deal with methods of hardening and softening and a consideration of theories put forward to account for these phenomena The last section of the book treats of some special properties of pure metals and alloys The author is an engineer who has evidently been quick to appreciate the fact that there are great possibilities of new knowledge being obtained in the study of the mechanical properties of single metallic crystals

H C H C

Our Bookshelf

The Physics of the Developed Photographic Image By F E Ross (Monographs on the Theory of Photography, No 5) Pp 217 (New York D Van Nostrand Co, Rochester, N Y Eastman Kodak Co, London Kodak, Ltd, 1924) n p

IN 1921 the Eastman Kodak Co commenced the publication of monographs on the theory of photography, and this book by Mr Ross is the fifth of the series The work will appeal chiefly to astronomers and those interested in astronomy, since it is mainly with the questions of astronomical photography that the author is concerned It is divided into six chapters which deal with "The Developed Silver Grain," "Graininess," "Astronomical Photographic Photometry," "Sharpness and Resolving Power," "The Mutual Action of Adjacent Images," "Film Distortion

and Accuracy of Photographic Registration of Position." Throughout the book the historical development of the subjects treated has been emphasised in a way that makes it easier for the reader with no previous knowledge of the subject to understand the fundamental problems involved. The chapter on graininess, by A. C. Hardy, is exceptionally well written, and should be of interest to all those engaged on problems involving great magnification of photographic negatives, as in cinematography. Chap. ii. contains a vast amount of information on the methods of astronomical photographic photometry, *i.e.* the method of obtaining the magnitude of a star from its image as impressed on the plate, and, with the remaining chapters, shows to the reader what a host of pitfalls and difficulties in astronomical photometry arise owing to the complicated structure of the photographic plate.

Mr. Ross is to be congratulated on having brought together into one volume a mass of information largely unknown to the average photographic worker, and of great value to the astronomer. The criticisms which can be made are not serious. In a volume with such a comprehensive title one would have expected to find the question of light scatter by the negative treated in relation to the well-known fact that the photographic density depends on the degree of diffusion of the light, etc.—a fact which has caused uncertainty in density measurement ever since it was introduced in 1890 by Hurter and Driffield. The more mathematical parts of the book suffer in the same way as most of these monographs have done, though not to the same extent as some, in that the text is sometimes difficult to follow. The photomicrographs are very fine; especially will they be appreciated by those who know the difficulty of photomicrography at high magnification of cross-sections of emulsion layers. F. C. TOY.

College Manual of Optics. By Lloyd William Taylor. Pp. ix+236. (Boston, U.S.A., and London: Ginn and Company.) 12*s.* 6*d.* net.

THE co-ordination of laboratory and class work is usually a problem of much difficulty in physics courses above intermediate standard, so that not infrequently there is little if any attempt made in this direction. The manual under notice sets out to bridge the gap between the two lines of study. It would obviously be impossible to treat both comprehensively in one volume of reasonable dimensions, and probably the most serious criticism to which the book could be subjected would be in respect of the matter omitted from it. Undoubtedly the most interesting section is that dealing with diffraction and interference effects observed with one and two slits. The essential differences between the two phenomena are clearly brought out, and Michelson's astronomical application of the latter is for once intelligibly presented and, further, strikingly illustrated by a laboratory experiment. The section on the Michelson interferometer is particularly good, as one has a right to expect from a book associated with the University of Chicago. Yet curiously enough there would appear to be no mention of the remarkable achievements of the instrument in optical testing work. The Fabry-Perot interferometer receives something less than adequate treatment; the student would probably obtain a quite erroneous idea of the relative importance of the two instruments in modern high-resolution work. The echelon spectroscope is not even mentioned, but no doubt this is because it is not usually met with in a laboratory course.

There are one or two points in the chapter on polarimetry to which exception can be taken. For example, the Laurent polariser (which is described here) has long given place to the Lippisch (which is ignored) as a research and commercial instrument. Again, contrary to what is stated, a yellow light filter is indispensable when a sodium flame is employed as source, at any rate for considerable rotations. It is surely not permissible to employ white light and a filter in any polarimetric measurements; the filter which will supply even approximately monochromatic light under such conditions has unfortunately yet to be invented. But these are minor blemishes, more than counterbalanced by many merits. It is a stimulating and original book, refreshingly lucid and direct in its methods, and provides without doubt a very valuable supplement to the ordinary text-books of optics.

The Central Caribs. By William Curtis Farabee. (University of Pennsylvania: The University Museum Anthropological Publications, Vol. 10.) Pp. 299 + 40 plates. (Philadelphia: University Museum; London: Bernard Quaritch, Ltd., 1924.) 44*s.* net.

THIS sumptuously equipped and splendidly illustrated volume has all the virtues and some of the defects of the so-called "survey-work," that is, work carried on over an area very extended, relative to the time devoted to its study. Hence the traveller, unable to learn the native languages, has to rely on interpreters and informants; he has to collect material objects and to be satisfied with observations which can be made rapidly and yet correctly. It is possible in such work to obtain a clear idea of the material culture of a tribe and a general view of their beliefs and social organisation; to map out the differences between the peoples of the region studied; to signal strange customs of outstanding importance. The insight into the native ways of life and modes of thought, however, the intimate perspectives of their moral outlook, of their *Weltanschauung*, and of their social order are given only to those who have the opportunities and the patience indispensable for the study of the local idioms and for a life led among the natives.

Dr. Farabee has carried out his survey work among the Central Caribs exceedingly well. One tribe, the Macusi, were studied in some detail, the information about them taking up some three-fifths (about 140 pp.) of the text, while the remaining twelve tribes are dealt with on some 100 pages. The material culture of the Macusi is described at some length, and this part of the contribution is naturally the most satisfactory. Under the heading of "Social Culture" we find such subjects as clothing and ornamentation; music, dances and games; magic, belief and mythology, while only one page is devoted to "political organisation," and a few pages to marriage, family and kinship, *i.e.* the really sociological themes. This is natural, for sociology can be studied only very inadequately in survey work. But every statement found in this book is clearly

formulated and well documented, and we are throughout inspired with full confidence that the writer has not gone beyond what well-founded evidence warranted him to say This is the line of demarcation between worthless amateur gossip about "savages" which has been the bane of anthropology, and genuine scientific information, such as is given in the present volume

B M

Cours de Physique a l'usage des eleves de l enseignement superieur et des ingénieurs Par Prof Jean Becquerel Tome premier Thermodynamique Pp ix + 430 (Paris J Hermann, 1924) 25 francs

THIS massive volume forms the first of a series of seven in which Prof Becquerel proposes to deal with the various branches of physics One cannot but feel awe as well as admiration at the boldness of such an undertaking, but if the remaining volumes reach the standard here set, the author must indeed receive our congratulations on a truly monumental work Having faithfully accomplished the task of cutting the 430 pages of the present instalment, the reviewer would earnestly request the publishers to amend their methods by subjecting the remaining volumes to the guillotine

The author believes that in the idea of energy and in the principles of mechanics may be found a guiding line which should never be abandoned In the introduction he is careful to insist on the *experimental* basis of these principles, which are presented under an aspect compatible with recent progress in physics Before beginning the exposition of thermodynamics, which has evidently been greatly influenced by the work of Planck and of Poincare, the author discusses the discontinuous structure of matter and the kinetic theory of gases, acknowledging his indebtedness to the books of Eugène Bloch and of Jean Perrin By the aid of the kinetic theory and the idea of the disordered movement of the molecules, the principle of Carnot is rendered less abstract The statistical theory of thermodynamics, in which the author follows closely an exposition given by Langevin, gives precision to this idea

As a descriptive treatise the book is an excellent one, the difficulties and mistakes of the student are carefully considered, but a British engineer would expect to find more attention paid to the numerical application of the theoretical results H S A

The Atmosphere and its Story a Popular Presentation of the Science of Meteorology, free from Technicalities and Formulæ By Ernest Frith Pp 204 + 9 plates (London The Epworth Press, 1924) 6s net

IN his preface the author explains that this book is the outcome of daily explanations of the weather given to classes in meteorology at Clark University The notes of these classes, collected and amplified, are here presented in book form

The book is divided into four parts, one for each season of the year, the first section of Part I giving a few brief notes on methods of observation of wind, temperature, humidity, rainfall, and snowfall There follows a simple account of various physical processes in the atmosphere, supplying answers to many of the questions concerning the weather which strike the intelligent man in the street The author writes in the first place for Americans, and the details he discusses are the details of American meteorology In spite of this, however, his book can be recommended to the general English reader as a useful introduction to weather phenomena It is very well illustrated, the cloud pictures being in all cases selected from the U S Weather Bureau's new cloud chart

The author discusses in an interesting and instructive manner the rôle of moisture in the air, and the formation of fog, cloud, and rain The topics in each seasonal part are selected so as to appeal to the general reader, and discussed in such a clear manner as to instruct that reader in the physical processes which underlie weather The author has succeeded in writing a book which should appeal to a very wide public

Electric Cables, their Design, Manufacture and Use a Series of Lectures delivered in the Moore School of Electrical Engineering of the University of Pennsylvania By William A Del Mar Pp vii + 208 (New York McGraw-Hill Book Co, Inc, London McGraw-Hill Publishing Co, Ltd, 1924) 12s 6d net

THIS treatise gives a good account, both historical and scientific, of cable manufacture Wire was originally made by beating metal into plates, which were then cut into strips and rounded by hammering It is stated that the art of drawing metal through dies was probably invented in the fourteenth century, although it did not come into practical use in Great Britain before the second half of the seventeenth century The Birmingham Wire Gauge was the first attempt to standardise sizes The first scientific attempt was made by Brown and Sharpe in America in 1855 The diameters of the wires they fixed form a regular geometrical progression from the English size of No 36 (5 mils) to 4/0 (460 mils) As there are 40 sizes, the common ratio is the 39th root of 92, which is 1 123 nearly This gauge is now officially called the "American Wire Gauge"

It is interesting to see that the formulæ first given in Fourier's "Theorie analytique de la chaleur" are in everyday use in cable work Approximate values of the thermal conductivities of all the ordinary insulating materials used for cables are given, and the question of the grading of cables so as to enable them to resist puncturing by high voltages is discussed at length There is, however, a great deal of work still to be done, both by the mathematician and the physicist, before definite conclusions as to the value of the method can be reached

Crystals and the Fine-Structure of Matter By Prof Friedrich Rinne Translated by Walter S Stiles Pp ix + 195 + 15 plates (London Methuen and Co, Ltd, 1924) 10s 6d net

THIS translation has been made from the second edition of Prof Rinne's book on fine-structure of matter, which he has named Leptology (λεπτός) According to the preface the book was written largely for the general reader, but discussion of a large number of aspects of the subject (there are fifteen chapters) has necessitated much condensation, and it is doubtful if much of the matter will be intelligible to the layman This is noticeable in Chap iii, "Crystallography and

Leptology," in which all the standard X-ray methods and the general morphology of crystals are outlined in thirty pages The matter is very well selected and furnishes most stimulating reading, the book should prove most useful as an introduction to a detailed study of any aspect of crystallography The later chapters, dealing with crystals and chemical reactions, are particularly suggestive

The book is well illustrated, though there is, on occasion, insufficient reference to diagrams in the text There are some excellent photographs of prominent crystallographers There are constant references to the authors of fundamental researches, authors of other than German nationality receive perhaps rather less than their share of credit A suggested addition is that references to original sources should be included for some of the more fundamental work, it is, for example, difficult to form a clear picture of the methods of Polanyi and Schiebold from the few sentences given them in the book

Tudor Economic Documents being Select Documents illustrating the Economic and Social History of Tudor England Edited by R H Tawney and Eileen Power (University of London Historical Series, No 4) In 3 vols Vol 1 Agriculture and Industry Pp xiii+383 Vol 2 Commerce Finance and the Poor Law Pp ix+369 Vol 3 Pamphlets, Memoranda and Literary Extracts Pp viii+486 (London Longmans, Green and Co, 1924) 15*s* net each

It is difficult to see how a better selection of material than this could well have been made In three volumes the editors give us documents from every conceivable source, chroniclers, pamphleteers, close rolls, court records, which illustrate every aspect of economic life in the changing epoch of Tudor England They are not of interest to the economic historian alone, the student of literature and of social life will find much to interest him The English itself is, often enough, of that stately texture which reached its highest point in the stiff splendour of Sir Thomas Browne, and ballads like "Nowe a Dayes," and Bastard's epigrams, are of the very heart of a great folk-thought Special attention should be directed to the important, and hitherto unpublished, "Polices to reduce this Realme of England unto a Prosperous wealthe and Estate," which is one of those minor discoveries as noteworthy to reader as to editor It is a pity that the plan of the series did not permit of an ample introduction One would have given much to know the editorial view of a period they have illuminated so wisely H J L

Electrical Drafting and Design By Calvin C Bishop Pp vii+165 (New York McGraw-Hill Book Co, Inc, London McGraw-Hill Publishing Co, Ltd, 1924) 10*s* net

This book is intended to bridge the gap between what a man learns in a technical college and what he is required to do in the office of an engineer, a contractor, or a power company He should have had a two years' course in mechanical drawing, a knowledge of technical electricity including cables and machines He must also know the Wiring Rules and have some practical knowledge of wiring After giving instruction about making practical drawings, special cases are considered, such as diagrams for three-phase panels, outdoor sub-stations, house wiring, etc

The chapter on artificial illumination is very helpful After defining the foot candle and the lumen a discussion of how the coefficient of utilisation and the depreciation factor affect the lumens required is given and formulæ are developed which enable these to be taken into account The formulæ would not attract a mathematician, but as they take into account the dust and dirt which collect on the lamps, the ageing of the lamps as well as the coefficients of utilisation of the lumens by the various standard types of shades and reflectors which can be bought in shops, they are of practical value Full descriptions are given of standard screws, bolts, copper rods, etc We can recommend this book to the engineer

La technique du vide Par L Dunoyer (Recueil des Conferences-Rapports de Documentation sur la Physique Vol 7, 1re Serie, Conferences 17, 18 Edite par la Societe *Journal de Physique*) Pp 225 (Paris Les Presses universitaires de France, 1924) 15 francs

The volume under notice forms an important contribution to the study of high vacua, and its publication emphasises the great improvements which have been effected in experimental methods during the past ten years Chap 1 deals with various types of pumps, special attention being given to molecular pumps and to mercury vapour pumps Chap ii is concerned with manometers Some miscellaneous questions, such as the construction of connecting tubes, the elimination of occluded gas, and the analysis of residual gases, are discussed in Chap iii, and the last chapter deals with the production or improvement of a vacuum by means of absorbing materials or the electric discharge The author rightly attaches great importance to the work of Martin Knudsen on the flow of gas rarefied to such a degree that the mean free path of the molecules has become large in comparison with the diameter of the tube

Modern Practice in Mining By Sir R A S Redmayne Vol 1 *Coal its Occurrence, Value and Methods of Boring* Third edition Pp xvi+231 (London Longmans, Green and Co, 1925) 10*s* 6*d* net

This constitutes a new edition, the third, of the first volume of a series intended to cover modern practice in coal mining, this particular volume describing the occurrence and properties of coal, the methods of searching for coal by means of boring and deep boring in general The body of the work has not been greatly altered from the previous edition, but an additional chapter has been inserted in which some modern appliances and devices for determining the deviation of boreholes are described The consequence of this method of dealing with the subject is that the body of the work remains somewhat out-of-date For example, the bomb calorimeter is not even mentioned, though it is to-day the most generally used appliance for determining the calorific power of coal Although not a matter of technical importance, a protest may well be entered against such an irritating piece of false Latinity as "apparati"

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Copepods in the Northern Hemisphere

IT has long been recognised that the distribution of freshwater copepods has been profoundly influenced by the incidence of the glacial period, since the lake-districts which they inhabit are to a large extent postglacial catchment basins. It so happens that there is a general correspondence between the three leading sub-orders and the three principal life-zones of lakes, namely, the creeping Harpacticoida of the littoral zone, the swimming Cyclopoida of the neritic zone, and the pelagic Calanoida of the open water. In the genus Cyclops there are upwards of twenty species common to the fauna of Norway (representing northern Europe) and of Germany (representing central Europe). Two significant differences are the absence of *C. capillatus* from Germany and the absence of *C. prasinus* from Norway, both of these species occurring in Canada.

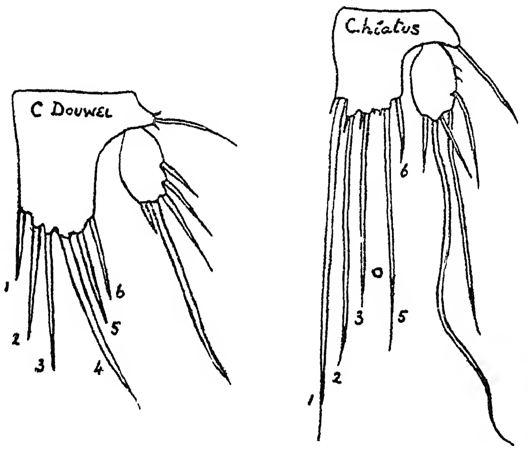

FIG. 1.—Fifth foot of female of *C. douwei* and *C. hiatus*.

The parallelism between the harpacticoid copepods in Europe and North America is remarkable. The writer has contributed to this subject in recent years, last year making the canoe trip to the great lake Mistassini, which lies beyond the Laurentian watershed and drains into Hudson Bay by the Rupert river. The genus Canthocamptus is intimately bound up with the Holarctic region, but the species are local and eclectic and they have to be searched for far and wide in likely places. The uncultivated area that occupies much of the northern portion of Canada offers a profusion of such places, pools, swamps, springs and quaking bogs, which are by no means easy to reach; but the offerings of the more accessible lakes are such as to stimulate one to plunge into the wilderness in quest of these insignificant inhabitants of the primeval sources. The rule is that they differ alike from each other and from their trans-atlantic relatives by clean-cut unit characters and, incidentally, they are frequently monogamous, thus exhibiting the phenomenon of segregation in all its phases.

The American forms differ, sometimes in the least apparent respect, sometimes in greater degree, from the European types, and this relation can be brought out by a tabular list, the knowledge of the items composing it being a secondary matter not necessary for the comprehension of the picture it presents. In two or three instances the differentiating characters are sufficiently intelligible to be mentioned. In *C. hoferi* the antennules are normal and 8-jointed; in its Canadian counterpart, *C. douwei*, they are 7-jointed. On the other hand, in *C. wierzejskii* the antennules are 7-jointed, and in the Canadian equivalent, *C. obatogamensis*, they are 8-jointed. Lastly, in *C. douwei* the fourth seta of the fifth foot is the longest of its set; in *C. hiatus* there is no fourth seta, and a gap, absolutely constant, is left for it (Fig. 1).

EUROPE	NORTH AMERICA
Canthocamptus staphylinus Jurine	*staphylinoides* A. S. Pearse
,, *minutus* Claus	*minnesotensis* C. L. Herrick
,, *vejdovskyi* Mrazek	*minusculus* Willey
,, *arcticus* Lilljeborg	*subarcticus* Willey
,, *hoferi* Douwe	*douwei* n. sp.
,, *fontinalis* Rehberg	*frigidus* Willey
,, *northumbricus* Brady	*northumbricoides* Willey
	hiatus n. sp.
,, *wierzejskii* Mrazek	*obatogamensis* n. sp.
Wolterstorffia confluens Schmeil	*Marshia albuquerquensis* Herrick
Laophonte Mohammed Blanchard and Richard	*L. calamorum* Willey

The above table does not exhaust the list of those that can be paired, and there are others which cannot be paired off. For example, *C. cuspidatus* Schmeil is represented here by an undescribed form (the new species named above are succinctly defined in this letter), while *C. illinoisensis* Herrick has no European double but appears in the ultramontane lakes and springs of Canada in a new form, *C. hyperboreus* Willey (Trans. Roy. Soc. Canada, 1925, in the press).

ARTHUR WILLEY.

McGill University, Montreal,
July 9.

The Effective Wave-length of γ Rays

IN his letter to NATURE (January 3, 1925, p. 13), Prof. Gray states: "If the secondary β-rays produced in light elements by the hard γ-rays of radium-C are recoil electrons with energy given by the quantum theory of scattering, . . . the effective wave-length of the γ-rays must be much smaller than that usually accepted. Without going into details . . . no theory, as at present developed, can account for the properties of scattered γ-radiation."

By means of Wilson's cloud expansion method, I have observed the β-rays which are excited in gases by γ rays hardened by 3 mm. of lead. It has thus been proved quite conclusively that these secondary electrons are recoil electrons, as predicted by Compton's quantum theory of scattering. These results, which Prof. Gray does not mention, permit me to draw some conclusions as to the effective wave-length of γ rays.

I obtained photographs of β-ray tracks in a homogeneous magnetic field and calculated the velocities of different separate β-particles from the curvature of these tracks. The corresponding results may be found in *Zeitschr. f. Physik*, v. 28, p. 285, October 1924 (see NATURE, Dec. 6, p. 838).

If we assume that the effective wave-length of the γ-rays is equal to 0.02 Å.U. as usually accepted (that means $h\nu$ equal to about 600 kilovolts), then the maximum limiting velocity of the recoil electrons, according to Compton's theory, must be 400 kv. Now, I found that out of 72 electrons for which the velocity was measured, 69 had a velocity smaller than 400 kv. and only 3 electrons showed an energy surpassing this value (the swiftest of the latter had a velocity about 1000 kv.).

It seems to me that these results disprove Prof Gray's statement "If they are recoil electrons, the effective wave-length of the γ rays must be taken as about 0 008 Å U in order that we may account, on the quantum theory of scattering for their observed energy" (A wave-length of 0 008 Å U corresponds to a maximum energy of recoil equal to about 1300 kv)

The main values of energy deduced from my data for electrons ejected at different angles to the primary ray also account for the usually accepted value (0 02 Å U) of the effective wave-length I may add that this order of value is confirmed by new measurements of Amahd and Stoner (Proc Roy Soc 106, 17 1924), who found 0 019 Å U as the upper limit of effective wave-length

It may be hoped that the direct counting of β-rays, and the measurement of their velocity will give a distribution of intensity in the γ-ray spectrum which differs from that obtained by the usual method By intensity is here meant the number of elementary quanta of γ-rays, and not, as is usual, their energy

Ellis (Proc Camb Phil Soc 22 p 374, 1924) obtained the γ-ray spectrum of radium-C where the most intense line (in the above meaning) seems to correspond to a wave-length of 0 02 Å U A strong line E34, lying near the limits of the spectrum ($\lambda = 0$ 00867 Å U) is twice less intense, and, according to Compton's theory, much less effective as to the production of recoil electrons

As to my disagreement with Prof Gray, I may state the following The method used by me has the advantage of making it possible to observe the undisturbed spectrum of secondary β-rays, which are produced directly in the gas In the case of a screen being the source of secondary β-rays, the distribution of velocities will be altered owing to the absorption of the rays in the screen itself, if we want to observe an undisturbed spectrum by the usual method, we ought to have β-rays excited in very thin layers of matter, which may be impossible so far as light elements are concerned

On my photographs there may be seen not only the tracks of the β-rays produced in the gas, but also the tracks of those rays which take their origin in the 2 mm thick wall of the chamber, in this case, we observe the secondary corpuscular radiation of the wall which is "hardened" by the wall itself, and the photographs show the presence of a comparatively larger number of swift electrons (most of these photographs show tracks of particles the velocities of which approach 1000 kv)

D SKOBELTZYN

The Polytechnical Institute,
Physical Laboratory, Leningrad, Russia,

June 29

Further Spectra associated with Carbon

DR R C JOHNSON, in an article with the above title which has just appeared (Proc Roy Soc, A, 108, 343, June 1925) has given in his Table IV a set of six new double-double headed bands, degraded to the violet, and associated with the comet-tail spectrum, which is also double-double headed, but degrades to the red I find that these new bands have the same set of initial vibration states as the first negative group of carbon, and this, in connexion with the relation stated in my letter of June 8 to NATURE, published in the issue of August 1, that the set of final states of the first negative group and of the comet-tail bands is the same, leads to relations of considerable importance in the quantum theory of band spectra

In the first place, the final states of the new bands must be identical with the initial of the comet-tail bands This is in fact the case, using the assignment of vibrational quantum numbers given in the letter just quoted This proves the correctness of that assignment and shows that the weak λ5281 band omitted in that assignment as well as the weak λ5764 and λ6354 bands are not a part of the regular group The values of the vibrational quantum numbers n'-n'', for Johnson's six bands in the order listed by him, are 0-1 1-2, 0-0 1-0, 2-0 3-0 Secondly, the frequency of the "origin of the new Johnson group must equal the difference in frequency of the origins of the other two groups This also is accurately true, provided one uses Baldet s (*Comptes rendus* 180 820, 1925) series interpretation of the comet-tail bands, and Blackburn's (Proc Nat Acad Sci, 11, 28, 1925) of the first negative group

More generally, from measurements of the frequencies of the individual lines of the comet-tail and first negative group bands, one can calculate immediately the frequency of *every line* of every band of the new group, *provided* the structure of the bands of the various groups has been properly interpreted, in working out the systems of energy levels It is this last fact which makes the above relations of such importance, for there is at the present time a sharp difference of opinion concerning the interpretation of a number of vital points in connexion with the series structure of complex bands such as these A fine structure analysis of Johnson's new bands should allow a definite decision on a number of these points

Without any further data, however, it is possible to decide definitely that the comet-tail bands have a *double* electronic level in the initial state of spacing $\Delta\nu = 126$ Each of these bands has a double "origin given by the heads of the two Q branches, according to Baldet's (*loc cit*) analysis, thus confirming this analysis in contradiction to Blackburn s (*Phys Rev* 25, 888, 1925) quite different interpretation Similarly the new bands each have a double origin with the same spacing ($\Delta\nu = 126$) This double origin is the second and fourth "head," counting from the *red*, while in the comet-tail bands it is necessarily the second and fourth head counting from the *violet* As might be expected, the theoretically inconsequential spacing of the first and second heads second and third, etc, in each band is not at all the same for the two groups, but the spacing of these two Q branch heads ("origins") is precisely the same

Other points at issue relate to the application of the combination principle to the rotational energy levels, the question of one-half versus one-quarter values of electronic momentum the numerical magnitude of the moment of inertia, etc They cannot be discussed in a brief communication like this, but Dr R S Mulliken in an article just sent to the Proc Nat Acad Sci, mentions some of the difficulties of interpretation in the case of these particular band groups

RAYMOND T BIRGE

Physical Laboratory,
University of California

On the Theory of the Zeeman Effect

IN his letter to NATURE of June 27, p 978, Prof W M Hicks points out that the theory of the Zeeman effect on the application of Larmor's theorem is no explanation, and concludes that the theory of the Zeeman effect on the quantum basis yet remains to be given

I may say that the classical theory can still demonstrate the Zeeman and Stark effects In the Proceedings of the Pont Academy of Sciences (March 1923) I

proposed a theory for both effects as a problem of perturbation in electron orbits, and last August I presented the same at the International Mathematical Congress at Toronto.

In the simplest case of circular orbits due to a central force (Coulomb's force) represented by the equations in polar co-ordinates

$$\frac{d^2r}{dt^2} - r\left(\frac{d\theta}{dt}\right)^2 = -\frac{\mu}{r^2}, \quad \frac{1}{r}\frac{d}{dt}\left(r^2\frac{d\theta}{dt}\right) = 0$$

we can introduce a perturbing force X due to a magnetic or an electrical field, and determine the variations produced in the characteristic quantities. For the primitive (non-perturbed) radius of the circular orbit, the X force introduces a correction ρ given by the equation

$$d^2\rho/dt^2 + n^2\rho = 3X \cos nt,$$

n being the average time of astronomers. We can integrate the equation in every hypothesis and deduce the variation of the periodic time n. Let X be the effect of a magnetic field H, then ρ results $\rho = \pm evH/mcn^2$, e, v, m, c being well known quantities, and the primitive periodic time becomes $n = n_0 \pm 3eH/2mc$, containing the explanation of simple Zeeman triplet.

If we assume the central force to be an elastic force, the solution becomes $n = n_0 + eH/2mc$, the well-known Lorentz's formula.

The more complex Zeeman effects may be deduced from elliptical orbits, and the solution gives also a displacement of perihelion in terms of classical methods.

G. GIANFRANCESCHI.

Gregoriana University,
Rome.

Science and Intellectual Freedom

MR. WELLS'S letter in NATURE of July 25, p. 134, fails to notice a most important distinction. Knowledge concerning the origin of species may be, and usually is, honestly and honourably desired for its own sake without any view of practical application. Knowledge concerning contraception is sought, either from mere prurience, or from intention to practise it or to teach others to do so. Many who hold that the State has no right to control its members' thoughts hold that it has the right to control their actions; and such persons, if they hold (as I do not) that the prevention of conception is wrong, may oppose the propagation of knowledge which has no value except in so far as it leads to such prevention, without being insincere in their desire for intellectual freedom.

There are, of course, doctrines, especially in ethical, political and economic theory, the intellectual and practical values of which are so closely associated that it is difficult to decide into which class they fall. But the solution of the problems raised by these border-line cases—which are those that cause real difficulty—is not aided by a refusal to recognise that they are border-line cases, and that the classes which they separate are generally distinct and present no difficulty whatever to a judicial mind.

NORMAN R. CAMPBELL.

The Isotopes of Mercury

THANKS to generous financial assistance, for which I am indebted to the Department of Scientific and Industrial Research, I have been enabled to build a mass spectrograph giving double the dispersion of the one previously in use. The final adjustments of this instrument are by no means complete, but it has already given results of great promise.

Preliminary photographs of the mass-spectra of mercury show its lines clearly resolved and so enable a definite statement to be made on the mass numbers of its most important constituents. These are six: 198 (4), 199 (5), 200 (7), 201 (3), 202 (10), 204 (2). The numbers in brackets indicate very roughly the relative intensity of the lines and, if we assume the whole number rule to be exact, correspond to an atomic weight in agreement with the accepted chemical one, 200·60. The possibility already suggested (*Phil. Mag.*, 49, p. 1196, 1925) that the mercury group might show a resemblance to that of cadmium is therefore borne out to some extent, although the extreme variation in the intensity of its lines appears rather less than in that element. On several of the mass spectra obtained there are faint indications of other lines, but a great deal more work will have to be done before these are proved to be due to isotopes of mercury or not; in any case their proportions are comparatively insignificant.

These results have a direct bearing on the claims recently made that under special conditions mercury has been transmuted into gold by the addition of an electron to the nucleus. It is clear that if the gold were so formed it would have an atomic weight at least as high as 198, that is, perceptibly higher than that of ordinary gold, 197·2. A definite determination on this point would seem to provide conclusive evidence on this interesting problem.

F. W. ASTON.

Cavendish Laboratory, Cambridge,
August 1.

Separation of the Depressor Principle from Hepatic Tissue

THE action of water-soluble substances prepared from hepatic tissue in lowering the blood pressure of normal animals has been noted in the literature for many years. Investigations as to the chemical nature of this principle which were initiated in this laboratory and the Department of Physiology eighteen months ago by Drs. James and Laughton, have yielded the following results.

The active principle is non-protein in character and is found in the abiuret fraction. It is soluble in water-alcohol solutions up to 80 per cent. strength. It is precipitated from aqueous solution by phospho-tungstic acid along with the diamino acid fraction, and the material recovered in aqueous solution can be further purified by extraction with ether, which has the capacity for dissolving out a very active principle which depresses the arterial tension and maintains it at a subnormal level for a long period.

The depressor substance is associated with a pressor principle in the abiuret fraction. These two are separated during the treatment with phospho-tungstic acid, since practically all the pressor element remains in solution.

Not only is the normal pressure reduced to subnormal levels but also artificial hypertension, induced by various well-known pressor substances, is similarly reduced to any desired level depending on the dose employed.

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The Problem of Stellar Evolution

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THE great problem of the evolution of the stars may be attacked along two main lines. We may study the properties of the stars themselves, as revealed by observation, and find orderly sequences among them; or we may analyse, on general physical principles, the constitution of a mass of gravitating matter, and the probable sequence of its changes.

Advances on these two fronts have shown a certain tendency to alternation. Lockyer's conception of stars of rising and falling temperature was based mainly on general physical considerations. The recognition of the sequences of giant and dwarf stars lent strong support to this theory, and—as the present writer showed some eleven years ago—a great mass of observed details fits in with remarkable completeness with the idea that the stars rise in temperature until the gas in their interior becomes compressible only with difficulty, and then cool down again.

More recently, progress has been mainly on the theoretical side, and has been very rapid. Among the milestones on the way may be noted the application of the theory of radiative equilibrium to the internal constitution of the stars, the appreciation of the fundamental importance of radiation pressure in this equilibrium, and of ionisation in making the mean molecular weight low and almost independent of chemical composition—then, recently, the development of rational, rather than empirical, expressions for the elusive opacity-constant, and the recognition that the dismembered atoms inside the stars are so small that even at enormous densities the material must behave like a perfect gas. Several investigators—Jeans, Kramers, Eggert—have contributed to this field, but much the largest share is Eddington's.

Meanwhile, observation has established conclusive evidence—with the joint help of astronomy, physics, chemistry, geology, and biology—that the life of the sun must be enormously long, and that the stars must have within themselves some vast store of potential energy, of hitherto unimagined extent.

These new developments must obviously lead to changes in the theory of stellar evolution to which reference was made above. One frank, but not unfriendly, critic recently characterised these changes as "sudden death." The writer—remembering Mark Twain's response to the rumour of his own demise—believes that in this case, too, the reports have been "greatly exaggerated."

On one point there can be no possible doubt. The feature of the older theory which assumed a fall of internal temperature in the denser dwarf stars owing to the close-packing of the atoms, must be finally abandoned. Eddington's argument is conclusive, and it is clear that the low surface temperatures of these stars must be ascribed, not to low internal temperatures, but to the increase of opacity with density, which prevents the heat from leaking out quickly to the surface.

The theory of the internal constitution and the luminosity of the stars is now really in a fairly satisfactory state. The relations connecting the mean molecular weight and the opacity-constant with the temperature and density appear to be well enough known to assure us that the approximations used by Eddington and Jeans must be close to the truth. Only one quantity remains uncertain—η, which represents the ratio of the average rate of generation of heat per gram in the portion of the star within a given distance of the centre to the corresponding quantity for the whole star—and Eddington has just shown that great changes in the law of its increase toward the centre affect the surface characteristics of the star but little.

Though approximations must be made in the solution of the equations, and opinions differ as to which is best, the main results are clear. The luminosity of a star (its total radiation) increases rapidly with increasing mass, but changes relatively little with the surface temperature, so that the influence of the latter may be expressed by a subsidiary correction—which rarely, if ever, reaches one magnitude, if the solar type is taken as standard.

The new theory, therefore, indicates that a star of given mass must be not far from a definite absolute magnitude, but may have any radius, surface temperature, and spectral type (the old restriction to densities less than a certain limit being unfounded).

The first of these conclusions is strikingly confirmed by observation, both for the most accurate individual data and for averages covering all the available material.

The second, however, is in definite disagreement with the facts. The stars of a given mass—or a given absolute magnitude, which are far easier to pick out, and afford an equally good test of the theory—are by no means indiscriminately distributed among the various spectral classes.

Among the brightest stars, it is true, all spectra are found; but among stars of not more than ten times the sun's luminosity, a large majority of those of given brightness are found within narrow spectral limits. Observational selection is much less disturbing if the grouping is made in this way, and there can be no doubt of the reality of the phenomenon.

From this viewpoint the stars may be divided into three groups.

1. The main sequence (a name suggested by Prof. Eddington), for which the luminosity diminishes rapidly, with increasing redness. This sequence includes most of the O, B, and A stars and all the ordinary dwarfs, and represents the most pronounced axis of concentration of the points upon the familiar diagram in which absolute magnitude is plotted against spectral type.

2. The giants—lying on the bright side of the main sequence, with representative points widely scattered, but showing a fairly definite axis of concentration, joining the main sequence near class F, and running somewhat upward for the redder stars.

3. The white dwarfs, of low luminosity and high surface temperature. Few such stars are yet known, but there are three of them within six parsecs, and they must be more abundant per unit volume of space than any other class except the K and M dwarfs.

Fig 1 shows the relations for twenty typical stars (taken mainly from Eddington's list) Nos 6 to 18 clearly indicate the main sequence Nos 1 to 5 give a sketchy idea of the giants, and 19 and 20 are the most notable white dwarfs

To account for this distribution, something more than the internal equilibrium of the stars must be considered The problem is intimately bound up with that of the source of stellar energy, and the probable secular diminution of stellar mass

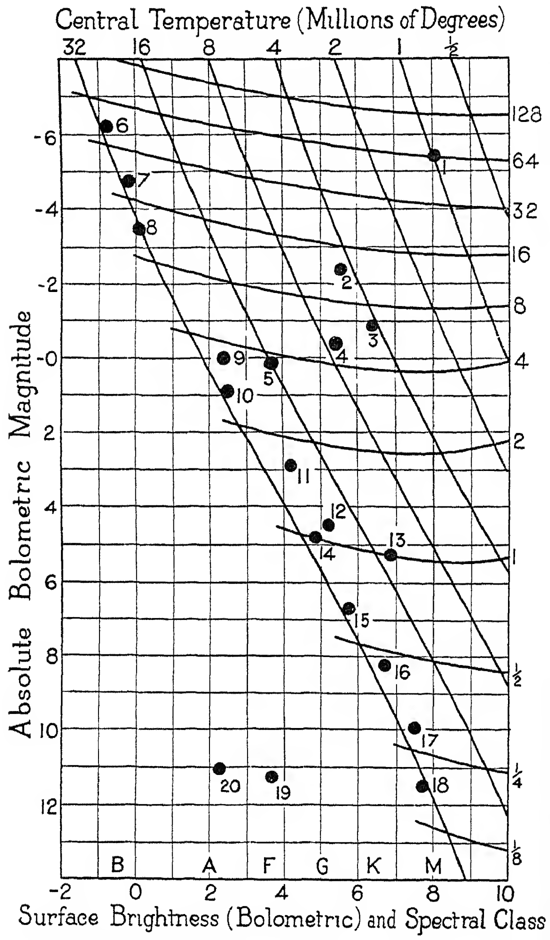

Fig 1 —1, Antares 2 δ Cephei 3 Arcturus 4 Capella A 5 Capella B 6, Plaskett's star 7 ζ Puppis 8 ζ Cygni 9 β Aurigæ 10 Sirius A 11, Procyon 12 α Centauri A 13 α Centauri B 14 sun 15 ξ Bootis A 16 ξ Bootis B 17, Kruger 60 A 18, Kruger 60 B 19 Sirius B 20, O$_2$ Eridani B

All commentators agree that if the mass of a star remains nearly constant throughout its history, no comprehensive scheme of evolution appears to be possible But, if the major part of the mass can ultimately be transformed into energy and radiated away, the problem becomes more hopeful

The first question to be considered is whether the rate of transformation of matter and generation of heat within a star is independent of the temperature and pressure, or not If the former is true, the star must expand or contract until the rate of loss of heat from the surface balances the unalterable income, if the latter, until the rate of production balances the loss

An accumulation of heat inside a gaseous star compels its expansion Unless this is accompanied by an increase of the loss of heat from the surface, a star of which the internal income of heat is fixed cannot be in stable equilibrium Even if the outgo balanced the income at the start, the slightest deviation would go on increasing, until the star either expanded indefinitely or contracted to minute size Now recent theory indicates that it is very probable that increase in diameter, and fall of surface temperature, go with decrease in total radiation Hence, as Eddington points out, the theory that the rate of generation of heat is independent of the internal conditions appears to be untenable

If this rate varies with the temperature (or perhaps with the density) it is practically certain that it must increase rapidly as the temperature rises—for there is certainly no considerable generation of heat inside the earth In this case the expansion of the star lowers the internal temperature, and cuts off the excess supply of heat, and the adjustment to such a condition that just enough heat is generated to supply the leakage to the surface will be automatic and stable

It appears, therefore, necessary to conclude that the rate of transformation of matter into energy increases with the temperature The thermodynamic difficulties in the way of this hypothesis are serious, but probably not insuperable

Here, however, we can no longer call our present knowledge of the general properties of matter to aid in solving the specific problem, rather we must once more be guided by the observed astrophysical data

The two sets of curves in Fig 1 are computed from Eddington's theory (Monthly Notices, R A S, 84, 104, and 308, 1924) (taking fuller account of the probable change of molecular weight) and represent stars of fixed mass or fixed central temperature

It is at once obvious that all the stars of the main sequence have very nearly the same central temperature—about thirty million degrees A theory based on different approximations might not make these temperatures come out so remarkably alike, but would still leave them very similar The giants are cooler inside, and the white dwarfs must be hotter, though numerical calculations are unsafe for such great densities

The concentration of stars along the main sequence can now be simply explained by assuming that, in the neighbourhood of a temperature of about thirty million degrees, the rate of transmutation of matter into energy increases very rapidly A higher central temperature than this would generate heat faster than it could escape, the star would expand and cool, and, practically, it could not pass this limit One would expect the internal temperature to be somewhat higher for the stars of great luminosity (which radiate more heat per gram) An entirely permissible change in the constants of the theory would allow this

If all the matter in the stars behaved in this way we should expect a star to pass through the giant stages precipitately, since the generation of heat at lower internal temperatures would not suffice for equilibrium This is evidently not the case, so that it is necessary to postulate that there are also one or more forms of matter which are transformed at lower temperatures,

and supply the "fuel" for the giants Some highly refractory constituent seems to be indicated by the white dwarfs

The first stage of a star's history which can be clearly visualised is, then, a sphere of very rarefied gas, comparable in diameter to the orbit of Uranus or Neptune, and with a central temperature of a few hundred thousand degrees Losing heat by radiation, it contracts, at first very rapidly, drawing upon its gravitational energy When the central temperature reaches some critical value—probably rather less than a million degrees—the degradation of some form of matter (either wholly into energy or into some less massive form, with corresponding energy-emission) begins, and a star is born The rate of evolution now depends on that of the exhaustion of the transformable material, and, as this is used up at the centre, the star must slowly contract so that the temperature rises, and new regions, nearer the surface, become the main seat of the transformation

If, as von Zeipel believes and Jeans doubts, there is active mixing by radial convection, the region of transformation will be less localised, but the general result the same—the temperature rising, as the quantity of exhaustible material diminishes, in order to keep up the rate of liberation of heat Several successive processes of this sort, involving the transformation of various kinds of matter with different critical temperatures, may be operative during the giant stage

We must next suppose that as a temperature of some thirty million degrees is approached, a process comes into play which leads to the actual annihilation of the main mass of the stellar material, with a correspondingly great liberation of energy The central temperature will then remain nearly constant, and the star steadily decrease in mass, "burning itself away" at the hot centre, gradually growing dense and more opaque, and passing down the main sequence

Finally, to account for the white dwarfs, we must believe that there exists a certain residue of refractory material, immune to transformation at thirty million degrees As the main constituents become exhausted this will preponderate and at last be almost exclusively present If this residue were incapable of transformation, rapid gravitational contraction would ensue until even the ionised atoms were jammed close together The considerable abundance of the white dwarfs per unit of volume suggests, however, that further energy-liberating changes occur and delay the last act

The course of evolution would then be represented, on the familiar diagram, not by a reversed figure 7, but rather by a reversed letter *Z* During the giant stage the surface temperature rises, and the representative point moves to the left Then along the main sequence it falls, and the point moves downward and to the right Finally, the star becomes a white dwarf, the temperature rises, and the point moves to the right again

Whether the lines representing the giant and the white dwarf stages run nearly horizontally, or downward to the right, depends upon the loss of mass in these stages—that is, upon the quantity of matter available for transformation within the corresponding ranges of temperature The large number of the giants suggests that a considerable fraction of a star's mass is lost during these stages, and that the evolutionary line slopes downward

If the easily transformable material becomes nearly exhausted before the main transformation sets in, there will be a period of relatively rapid change between the redder giants and the main sequence, and such intermediate stars will be statistically infrequent, as appears to be actually the case

Too few white dwarfs are known to justify a similar discussion

It should be especially noticed that while, on the theory here proposed, all stars should pass along at least a part of the main sequence, they may be very different in the other stages A star of great initial mass would give an evolutionary line crossing the diagram near its top, and joining the main sequence at class B or class A One of small mass might come in at F or G, or even lower The existence of such stars, intermediate between the redder giants and dwarfs, is therefore no argument against the theory either in its present form, or for that matter, in the older and abandoned one

The fainter component of α-Centauri—as Fig 1 shows—seems to be a star of this sort, and, from the present viewpoint, would be classed as a giant of small mass (as must also be the large red companions of such eclipsing variables as U Cephei)

Similarly the level at which a star would break away from the main sequence, and become a white dwarf, would depend on the quantity of "refractory" matter originally present (or perhaps formed as a by-product of other transformations), and any combination of absolute magnitude and spectral type is possible

This scheme of stellar evolution is very similar to its predecessor The only important point of difference is (as Eddington puts it) "that the diminishing brightness in the dwarf series is due to decreasing mass, and not to a falling off in compressibility" On the other hand, the difference of mass between giants and dwarfs is now explained, and the white dwarfs—formerly most puzzling—now, thanks to Eddington, find an orderly place at the end of the sequence

The notion of the transmutation of mass into energy, upon which the new theory is founded, appears to rest upon strong evidence The specific types of transformation postulated above are frankly adopted *ad hoc*, as indicated by the observed statistical facts, but while the subject is still outside the range of existing theories of the constitution of matter there is nothing else to do, and so far as can be judged, the postulates seem plausible enough

The youngest known stars (not in years, but in evolution) appear to be those of class N and Me, and it is probably no accident that practically all of these are variables The latest known stage, judging by the density, is found in the companion of Sirius This is abnormally faint for its mass, and it may be, as Eddington suggests that close-packing of the atoms is beginning to have an influence here (at a central density of the order of one ton per c c !)

The final stage is still uncertain Either the loss of mass continues indefinitely until the star practically disappears, or else close-packing halts the rise of temperature, before the most refractory atoms can be

annihilated. In the latter case the star must ultimately cool down.

There seems little reason to suppose that it would ever return to a "normal" density. Ordinary matter, subjected when cold to increasing hydrostatic pressure, should break down to a state of far smaller volume in which the valence electrons wander freely, while the complete shells of electrons normally inside these approach almost to contact as soon as the work done by the compression exceeds the ionisation energy required to tear the valence electrons loose.

Further—and very great—increases of pressure should break down the *N*, *M*, *L*, and ultimately the *K* shell, and reduce matter to a formless state. Probably the greatest pressure which exists even in a white dwarf would not complete this process except for the lightest atoms; but the maintenance of a very high density, even if all the heat had been lost, appears entirely possible. Only the surface of such a body would be in the ordinary solid state; that of the interior would transcend our experience, but not our imagination.

Regions of Tension and Continental Drift.[1]

By Dr. J. W. EVANS, F.R.S.

IF the sima magma, when still in its original position under the heavy pressure of the superincumbent sial, remained at too high a temperature for crystallisation to take place, the magma and the rocks differentiated from it would be of the normal types. The temperature-gradient, however, in the great masses of sial (the continental shields of some authors) shows a relatively slow increase in depth; consequently, a comparatively low temperature may be found at their under surface, a temperature sufficiently low for some crystallisation to take place.

In these circumstances it may be expected that crystallisation will commence with those minerals or groups of minerals that have a small molecular volume; small, that is to say, for the elements which they contain. Corresponding to these there are usually minerals or combinations of minerals having the same chemical composition but greater molecular volumes, which crystallise under low pressures. Among the high-pressure minerals with small molecular volumes are garnet, zoisite, epidote, kyanite, muscovite, biotite, and diamond. The low-pressure minerals with large volumes include anorthite, orthoclase, andalusite, and graphite. Albite and water have relatively large volumes, but have for practical purposes no small-volume representatives.

Dr. F. Becke has shown[10] that igneous rocks formed originally at moderate depths, have, when subjected to great pressure, certain minerals changed into others with greater density: for example, orthoclase into muscovite and quartz, and lime-soda plagioclases into albite and zoisite. He gives the following equation:

$$\begin{array}{llll} \underbrace{x(\mathrm{NaAlSi_3O_8}) + 4(\mathrm{CaAl_2Si_2O_8})}_{\text{plagioclase}} & + \mathrm{KAlSi_3O_8} & + 2\mathrm{H_2O} & \\ \text{albite} \quad \text{anorthite } 402.8 & \text{orthoclase } 108.3 & \text{water } 36 & \\ = x(\mathrm{NaAlSi_3O_8}) + 2(\mathrm{HCa_2Al_3Si_3O_{13}}) & & & \\ \text{albite} \quad \text{zoisite } 275.8 & & & \\ + \mathrm{H_2KAl_3Si_3O_{12}} + 2\mathrm{SiO_2} & & & \\ \text{muscovite } 141.1 \quad \text{quartz } 45.6 & & & \end{array}$$

The figures under the names of the mineral substances other than albite, which is unaltered, express their molecular volumes. It will be found that the total of these volumes under low pressure is 547.1, and under high pressure only 462.5.

When, therefore, plagioclase is subjected to sufficiently high temperature and pressure in the presence of a little water, and is decomposed in the manner described by Becke, the albite portion appears to go into temporary solution, and either recrystallises as water-clear albite *in situ*, or is the agent of the albitisation of neighbouring rocks, giving rise to the formation of spilites, spilosites, desmoisites, or adinoles. It is reasonable to suppose that the minerals which crystallise out from amorphous magmas under heavy pressure will be similar to those into which other minerals already crystallised are transformed under similar conditions of pressure and temperature.

It is, however, the garnets which are chiefly characteristic of rocks that crystallise under especially heavy pressure. Dr. L. L. Fermor[11] has described the occurrences of rocks in the Province of Vizagapatam (India), which appear to have been crystallised under such conditions.

These rocks are characterised by the presence of garnets which, under normal conditions of crystallisation, would have been replaced by anorthite, augite, diopside, hedenbergite (iron-diopside), wollastonite, olivine, tephrite (manganese-olivine), and magnetite. The garnetiferous rocks are calculated by Dr. Fermor to occupy 20 per cent. less space than their low-pressure equivalents. They contain orthoclase, although this, as we have seen, may be transformed under special conditions of pressure into muscovite and quartz, but they contain no soda-minerals. Presumably, under the conditions that prevailed, these would remain in the fluid state the longest, and only crystallise when the temperature had been lowered still more. Apparently they were pressed out in the fluid state from the Vizagapatam rocks, on a release of pressure, before this happened. These rocks appear to be made up of minerals which have crystallised out at great pressure below the under surface of the sial crust. Their crystallisation must have left a magma rich in soda and comparatively poor in the oxides of divalent minerals, such as lime, magnesia, and ferrous and manganous oxides.

We may expect a magma of this character to occur, either alone or in association with typical sima magma, in the molten magma arising from great depths in fissures formed in regions of tension. Such a magma

[1] Continued from p. 175.

[10] "Ueber Beziehungen zwischen Dynamometamorphose and Molekular volumen," *Neues Jahrb.* vol. 2 (1896), pp. 182-83.

[11] "Garnet as a Geological Barometer and an Infra Plutonic Zone of the Earth's Crust," Rec. Geol. Surv., India, vol. 42 (1913) pp. 41-47.

is one that would give rise by differentiation to the series of alkali-rocks. These are characterised by low proportions of iron, lime, and magnesia, and an excess of potash, soda, and frequently alumina. In normal rocks the alkalies and lime of the felspars are accompanied by an equal molecular amount of alumina. The magnesia, the iron-oxides, and the remainder of the lime are also usually associated in many monoclinic pyroxenes and amphiboles with alumina. If a considerable proportion of the magnesia, iron-oxides, and lime be removed in the form of garnets, less than one-third of the equivalent proportion of alumina will go with them, so that it is not surprising that the percentage of alumina in the residue should be high, especially if, as appears frequently to happen, little or no zoisite or epidote is formed. In some instances, however, a certain number of the garnets formed at great depths are carried up with the alkaline magma.

The alkali rocks are sometimes found alone, as in the neighbourhood of Montreal and many localities on both sides of the Atlantic; but frequently they occur as occasional exceptions in a vast upflow and outpouring of normal rocks, mainly, but not exclusively, of basic composition. Examples of such modes of occurrence are met with in the Tertiary igneous rocks of the British Isles. Other examples of this association of normal and alkali-rocks occur in Scandinavia, India, and Australia.

Beyond the Eastern Atlantic deeps to which reference has been made lies the Central Atlantic bank, rising some 6500 feet (2000 metres) above the ocean-floor on either side of it. It only shows at the surface by virtue of local eruptions of volcanic rocks, mostly basic, but including occasional alkali-rocks, such as those of Rockall, which, however, is surrounded by a basaltic plateau close below the surface of the sea. The mass of the ridge must, however, consist of acid or sedimentary rocks, such as compose the continental masses. If it were not made up of such lighter rocks, it would not continue to exist. Whenever eruptions or earth-movements may, for the time being, disturb the isostatic equilibrium in any area, the forces of gravity acting on the yielding rocks of the earth's crust tend to restore it. Whatever may be the inequalities of the depth of the sea, they are compensated by the variation in the density of its bed. The only exceptions are minor irregularities so small that they can be maintained by the strength of the rocks, or so recent that the slow forces of readjustment have not had time to operate.

West of the central ridge is another ocean-deep formed in all probability by the same process of rifting, in the course of which the eastern margin of the North American continent drifted away to the westward. These Atlantic rifts represent far greater relative horizontal movements than those affecting western Europe, but they seem to be essentially similar in nature. The total displacement, towards the west, of eastern America relatively to western Europe would appear to vary from about 3000 miles (5000 km.) in the south of the North Atlantic to about 1400 miles (2300 km.) in the north. As Wegener claimed to be the case, the movement seems to have been largely in the nature of a rotation about a point in the far north. He thought, however, that the east of North America and the west of Europe were once actually in contact; whereas, according to my view, they were still separated in later Palæozoic times by an area, much narrower than the present Atlantic, which was sometimes wholly terrestrial and sometimes partly occupied by shallow mediterranean seas with a roughly north-and-south trend, one on the east and one on the west. They seem to have been to a great extent independent, for the marine faunas preserved in the later Palæozoic rocks of western Europe are strikingly different from the contemporary marine faunas in eastern North America, indicating the probable existence of a land-barrier between them. When, on the other hand, marine conditions were replaced by terrestrial, the similarity of the fossils and of the climatic evidences would seem to prove the existence of a continuous land-area.

When the rifting occurred, the rocks of the central land must have been fissured like those of Devon and Cornwall, and slipped away partly on one side and partly on the other, so that they no longer appeared above the sea, nor was the isostatic adjustment sufficient to raise them to the surface. The volcanic accumulations which form islands at various points on the central bank show a local excess of gravity. This indicates that their elevation is comparatively recent, so that isostatic adjustment is not yet complete. When it is, they may be wholly submerged, an event which would be hastened by subaerial and marine erosion.

A similar succession of events appears to have taken place in the South Atlantic. There the remarkable resemblance between the rocks on the opposite shores—ranging from the Devonian to the Jurassic—both in lithological characters and in fossil contents, seems to lead almost inevitably to the conclusion that they were once in much closer proximity, though probably not in actual contact, as supposed by Wegener, for there, too, is an important mid-oceanic ridge from which volcanic islands rise to the surface.

Much of the structure of the African continent has yet to be determined; but, so far as it is known, it appears everywhere to support the view that there is evidence of the prevalence of tension directed outwards from the centre. This is in accordance with Wegener's contention that at the beginning of Mesozoic times there was a great "Ur-Kontinent," of which Africa was the centre, and that it has since been broken up by a relative movement of South America to the west, of west Antarctica to the south-west, of India to the north-east, of Australia to the east, and east Antarctica to the south-east.

Dr. R. Staub,[12] however, contends that, like India, Africa itself has moved northwards and given rise to the Eocene (Alpine) folding of Europe.

The question of the origin of regions of tension must now be considered. Why should they exist, or, to go one step further back, why should different portions of the continental masses tend to move apart from each other?

On the whole, the movement and the corresponding tension are roughly east and west, though frequently more or less diverted by local circumstances. This prevalent direction naturally suggests that it is in some

[12] 'Der Bau der Alpen.' Berne, 1924, pp. 78.

was determined by the rotation of the earth, and is a result of tidal retarding action Now, the rate of the retardation of the earth's rotation is known from astronomical evidence to be approximately an increase of 9 seconds in a century, per century,[13] and there seems reason to believe that this may all be accounted for by the friction of tidal currents in shallow seas (that in the oceans being negligible), so that it is apparently unnecessary to call in friction produced by the tides in the solid substance of the earth It is claimed too that these tidal movements are so small —of the order of 1 metre, or 10^{-7} of the earth's linear dimensions—that the earth must be considered for this purpose as perfectly elastic, and that any purely elastic distortion of the earth can have no retarding effect[14]

The first objection ignores the fact that, if there is a tidal deceleration, there is also an acceleration due to the secular contraction of the earth, which must, as I hope to show on another occasion, be considerable Even the decrease in the ellipticity of the earth, itself due to a decrease in the velocity of its rotation, involves an acceleration which prevents that decrease from being so great as it otherwise would be The retardation of the earth's rotation is therefore the difference between a decelerating and an accelerating effect, and these may be and probably are much greater than the difference between them In other words, the deceleration, which is the measure of the effect of tidal friction on the earth, is equal to the retardation deduced from astronomical observations *plus* the acceleration due to the earth's contraction and change of form Indeed it is possible that at an earlier period the acceleration may have been greater than the deceleration

With regard to the second objection, I have recently shown[15] that the tidal distortion in the more superficial zones of the earth is much greater than in those at greater depths, and it would appear that in the former the ratio of the distortion to the total thickness of the zones would be of the order of 5×10^{-6}, fifty times as much as for the whole earth Therefore the internal friction (the hysteresis, so to speak) in elastic distortion may not be negligible—especially as the outer crust is far from homogeneous, being subject to numerous forms of discontinuity, such as, on a small scale, the boundaries of crystals, sand-grains, pebbles and fragments, besides planes of weakness in the crystals themselves, and, on a large scale, stratification, lamellation, foliation, cleavage, joints, faults, unconformities, and intrusions Everywhere there are occasions of imperfection and inequality in mutual mechanical reactions, so that elastic distortion must frequently give rise to movements between surfaces in contact, with resulting friction and absorption of energy In many cases forces tending to produce such a result are already acting, and only require a slight addition in order to overcome the resistance opposed to them

There seems, therefore, every reason to suppose that there are, even apart from the friction in shallow seas, forces tending to retard the rotation of the earth and especially of the outer zones, consisting mainly of crystallised igneous rocks and sediments, and thus to produce a movement of the exterior relatively to the interior from east to west

These considerations unfortunately leave unexplained the divergent relative movement from Africa of the other constituent parts of the "Ur-Kontinent"—why the Antarctic continent should have drifted to the south or (alternatively) Africa to the north, or why America should have been retarded by tidal friction more than Europe-Africa, and Africa more than India and Australia

There are, however, other possibilities that may explain the relative movement of portions of the earth's crust According to Wegener, the sial, which in primeval times had covered the sima over the whole earth, had in the late Palæozoic era been restricted, so as to extend over little more than the fourth part, but it had become at the same time correspondingly thicker, as a result of the extensive folding that it had suffered It then, as already stated, occupied a single area, of which what we now know as Africa was the centre, although there is evidence that some portions were covered by shallow seas just as the present Mediterranean Sea now covers a part of the Old World continental area

We have seen that since Hercynian times it has split up, different portions moving away in different directions The evidence adduced by Wegener renders this at least a plausible hypothesis He ascribes these changes to different rates of westward movement, and a drift away from the Poles, but a general drift from the centre of Africa to the centre of the Pacific seems to represent the real character of the movement more happily Prof H Darwin explained such a movement by the hypothesis that the moon was, more than 50,000,000 years ago, thrown off from what is now the Pacific, and took with it much of the lighter surface-rocks, the sial in fact, which then occupied that part of the earth, and that the remainder has since been drifting towards the region of high density thus caused If so, it would seem to have been held back by the resistance of the floor of the Pacific, and this has given rise to the circle of folded mountains which surrounds that ocean Dr H Jeffreys,[16] however, believes that the earth gave birth to the moon when the young mother had herself only existed some 10,000 years, and that this must have occurred more than 1,000,000,000 years ago He gives reasons for believing that the earth was then almost fluid, with at most a thin solid crust on the outside This, in the violent agitation that took place during the process, must have been broken into fragments which would have forthwith spread themselves out in such a way as to become roughly distributed over the earth[17] In any case, it would be inconceivable that the drifting towards the centre of the Pacific should have been delayed until nearly the end of the Palæozoic era Of course, if the birth of the moon could have taken place in late Palæozoic times, when the earth's crust was already consolidated, and if it could have occurred, while

[13] That is to say the length of a day now is $9/(100 \times 365\frac{1}{4})$ of a second more than it was a century ago It is usually assumed that this retardation affects the entire mass of the earth whereas it is probable that the retardation of the earth's upper zones is slightly greater than that of the interior If this be so a correspondingly less amount of friction will be required to produce the observed result

[14] H Jeffreys, The Earth 1924 chap iv The effect of elastic viscosity (which involves permanent set or flow) is excluded where the periods of distortions are as short as those of the tides for it is known to be inoperative with the Euler nutation, the period of which is considerably longer—fourteen months

[15] NATURE, vol 114 (1924) p 749

[16] The Earth (1924) chap iii p 77

[17] *Ibid* p 150 J H Jeans Proc Roy Soc, vol 93, A (1917), pp 413 17

allowing life to go on much as usual in other parts of the globe, there is no reason why the drift should not have taken place in Mesozoic and Kainozoic times; but, according to Jeffreys, the want of fluidity in the upper zones of the earth would then have rendered the separation impossible. Another objection to such an hypothesis is that there have been, during Palæozoic times and the long ages of the pre-Cambrian era, repeated occurrences on a large scale of mountain-building, folding, thrust- and slip-faults, and igneous intrusions and extrusions, so that there must have been repeated previous transformations similar to those that we can trace with greater distinctness in the immediate past. We cannot explain each of these by the birth of a satellite, for there is only one now existing.

There seems, however, to be a simpler hypothesis, which I will briefly indicate. The earth, as we know, contains a dense core surrounded by lighter material, the upper portion of which constitutes the sima. The sial is of course of comparatively insignificant thickness. It has been contended[18] that in the early history of the earth, when the resistance to compression and the rigidity were less, the heavy core was, on account of the earth's rotation, in a state of unstable equilibrium, and that, as a result, its centre of gravity probably does not now exactly coincide with that of the earth as a whole. Consequently, at that point on the equator to which the core is nearest gravitation is at a maximum. As, however, the attraction of the moon and sun results in friction which tends to retard the rotation of the earth's higher layers more than the interior, the former must have a slow movement relatively to the latter. We have seen that there is reason to suppose that in Palæozoic times the continental masses of sial were more or less concentrated round what is now Africa, forming the "Ur-Kontinent" of Wegener. This may well have been due to the fact that the maximum of gravity was then situated in that part of the earth. If then, during Mesozoic times, the movement of the higher layers of the earth had brought the centre of the Pacific into the position of maximum gravitation, the former great Palæozoic continent would tend to break up and drift apart towards the Pacific, and this is what appears to have actually happened. Similar changes may have occurred more than once in the earth's history since the remote time when the sial was spread over the whole globe.

It has been urged that the forces developed by the tidal action of the sun and moon, although large enough to cause a slow movement of the earth's crust as a whole, would not suffice to drive masses of sial through the sima, especially in the presence of the much larger compressive forces developed in the crust by the contraction of the earth's interior; still less to ruck up the earth's crust to form mountains tens of thousands of feet in height. It seems probable that this objection could also be urged against the adequacy for the same purposes of the forces developed by the variation of gravity from point to point on the globe, or against any combination of these two hypotheses.

To deal fully with this difficulty would involve the consideration of the principles of crustal compression and mountain-building, which I hope to discuss on another occasion. It will, I think, be at present sufficient to remark that, according to my view, it is precisely by the forces of compression that the crust has been folded and overthrust and the great mountain-chains raised up, but that the immediate result is the exhaustion, for the time being, of these forces and the simultaneous local destruction of the powers of resistance of the earth's crust, and that it is then and then only that the forces tending to cause the drifting of continental masses become free to act.

[18] J. H. Jeans, Phil. Trans. Roy. Soc., ser. A, vol. 201 (1903), p. 157; W. J. Sollas, Q.J.G.S., vol. 59 (1903), p. 180; A. E. H. Love, Phil. Trans. Roy. Soc., ser. A, vol. 207 (1908), p. 171, and NATURE, vol. 76 (1907), p. 327.

Obituary

DR. F. E. BEDDARD, F.R.S.

ZOOLOGY has lost a distinguished and devoted servant in the death of Frank Evers Beddard, which occurred at his home at Hampstead on July 14. He will be remembered best, perhaps, as the prosector of the Zoological Society, a post which he held for more than thirty years. He succeeded to great traditions, and worthily upheld them during his long term of office. Those who were privileged to listen to his discourses, at the scientific meetings of the Society, will ever remember his extraordinary facility of expression and the clear and rapid way in which he laid abstruse points before his audience. Few, probably, who were listening had ever made the dissections he was describing, yet so admirable was his presentation of the facts he had gleaned, that they could not fail to grasp the essential points laid before them. He had no rival in this regard.

Beddard's work on vertebrate anatomy covered a wide field, and though it may have been marked by no epoch-making discoveries, it maintained a high level of excellence. He has left, in the pages of the Proceedings of the Zoological Society, a rich storehouse of information for future investigators. His contributions to science, in the form of original work, were, however, by no means confined to the vertebrates. He wrote a memoir on the Isopod Crustacea collected by the *Challenger* Expedition, and a fine monograph on the Oligochæta, issued by the Clarendon Press. This was, perhaps, his favourite group, and embraces some of his best work.

In his books Beddard did himself less than justice. His volume on whales, for example, was good, but he could have given us a much better book. The same may be said of his volume on the classification of birds, and that on the coloration of animals. In these he seems to have shirked the labour of coming to a decision on the very vexed and controversial points which these two themes presented. He nowhere commits himself to a definite opinion as to whether he does or does not agree with the conclusions arrived at by others, whose views he sets forth without comment. His pages are almost too dispassionate to be helpful.

Beddard was elected a fellow of the Royal Society in 1892, and was the recipient of the Gold Medal of the

Linnean Society For some years he was lecturer on biology at Guy's Hospital, and he also acted in the capacity of examiner in morphology at Oxford, and in zoology and comparative anatomy in the University of London Finally, he was a man of great personal charm, who was always willing to put his wide knowledge and experience as a zoologist at the service of others

W P P

WHILE many can speak of Dr F E Beddard's zoological work in general, there must be few who knew his special work on the Oligochæta so well as myself For upwards of a quarter of a century we were in constant correspondence, exchanging papers, specimens or notes It is forty years since he began to publish on the subject of annelids Alongside of his professional work he had already spent at least ten years on the oligochæts before his *magnum opus* was issued by the Clarendon Press (' A Monograph of the Order Oligochæta," 1895) In the bibliography appended to this work no fewer than eighty-five items are recorded as his own, while Benham and Friend are each credited with twenty Beddard did not profess to pay special attention to the British annelids, and very few of the species described in his monograph have indications that they may be found in Great Britain His own material came from every part of the globe, but the tropical worms were perhaps those he knew best What he did for Asia in particular largely paved the way for the splendid work which Stephenson has done and is still doing When I took up the work in 1890, Beddard, together with Dr Benham, gave me every possible help, and as my work on British annelids, and particularly that on the Enchytræids, grew, he regarded that department as mine, and left me an open field He was ever ready to recognise the work of others, and never looked askance at one who worked as an amateur in the provinces with all the odds against him

In 1912 Beddard issued a little volume on " Earthworms and their Allies," but his output was so enormous that he had no time for cultivating a fine literary style If he has left behind little, however, that would make worms popular with the general public, his monographs and memoirs will always remain as a tribute to his industry, and as a mine of wealth for the specialist He will long be remembered as England's foremost authority on the Oligochæta

HILDERIC FRIEND

DR S T DARLING

AN eloquent appreciation, from the pen of Prof R W Hegner, of the life and work of Dr Samuel Taylor Darling, of the League of Nations Malaria Commission, appears in a recent issue of *Science* Dr Darling, it will be remembered, was killed, with two other members of the Commission, on May 20 in a motor-car accident near Beirut in Syria He is described by Prof Hegner as " one of the foremost American students of tropical medicine, especially in the field of medical zoology "

Dr Darling was born in 1872 and chose medicine as his career In 1903 he went to the Ancon Hospital in the Panama Canal Zone and three years later he was appointed chief of the laboratories of the Isthmian Canal Commission, a post which he held until 1915 During this time he took up the study of parasitic organisms causing diseases in man and animals and of malaria, and published some noteworthy papers on histoplasmosis, sarcosporidia, the malarial organism and its mosquito vectors, trypanosomiasis in horses, leishmaniasis, endamœbæ, and similar subjects In 1913–1914, Dr Darling accompanied General Gorgas on a sanitary mission to the Rand mines and Rhodesia and in 1915 he joined the staff of the International Health Board of the Rockefeller Foundation As head of a medical mission of the Board he spent two years studying the causes of anæmia among the peoples of Malaya, Java, and Fiji Some of the results of this mission appeared in a report, of which Dr Darling was part author, on " Hookworm and Malaria Research in Malaya, Java, and the Fiji Islands " He was then sent to Sao Paulo, Brazil, where he established a laboratory for teaching and investigation on these subjects, and in 1922, when the International Health Board decided to found a field laboratory for the study of malaria at Leesburg, Georgia, Dr Darling was chosen as the first director Here, according to Prof Hegner, he did some of his best work as an investigator and as a teacher, training men who were afterwards sent out on malaria control campaigns

Dr Darling was an honorary fellow of the Royal Society of Tropical Medicine and Hygiene, president in 1924–25 of the American Society of Tropical Medicine, a member of many other American and foreign learned societies, and of the National Malaria Committee His widow has presented his library to the Department of Medical Zoology of the School of Hygiene and Public Health, Johns Hopkins University, Baltimore, and it will be known as the Samuel Taylor Darling Library

WE regret to announce the following deaths

Dr Charles W Burrows, formerly head of the magnetic section of the U S Bureau of Standard, who was distinguished for his work on magnetic testing and on the magnetic properties of alloys of iron on May 2 aged fifty years

Dr David T Day for twenty years head of the department of mining and mineral resources of the U S Geological Survey, who made a special study of the constitution of petroleum and its derivatives, on April 16 aged sixty-five years

Prof Louis Gentil, professor of physical geography at the Sorbonne, Paris and member of the Paris Academy of Sciences distinguished for his exploration work in Morocco and other parts of northern Africa, on June 12 aged fifty-six years

Dr J Guillarmood a distinguished Swiss geographer and explorer and the author of several works on the Himalaya on June 6, aged fifty-seven years

Dr I Minis Hays, secretary general of the International Medical Congress held at Philadelphia in 1876, and secretary since 1897 of the American Philosophical Society, on June 6, aged seventy-seven years

Prof F R Japp, F R S, emeritus professor of chemistry in the University of Aberdeen, on August 1, aged seventy-seven years

Dr E J McWeeney, professor of pathology and bacteriology in University College, Dublin (National University of Ireland), and bacteriologist to the Local Government Board on June 20, aged sixty-one years

Current Topics and Events

THE German Chemical Society has recently published a "warning" directing attention to the very large numbers of young chemists now coming from the universities, many of whom are unable to find suitable employment Figures are given showing the extraordinary increase in graduates from the chemical faculty, as compared with those from other departments of the universities It is anticipated that the number of chemical graduates this year will be about 1100 whereas it is computed that German industry is only able to absorb about one-third of that number, that is to say, about 350 per annum Opportunities abroad for German chemists are now considerably less than they were before the War, partly for political or sentimental reasons and partly because of the growing tendency in most countries having industrial aspirations to develop their chemical industry by employing their own chemists to the almost total exclusion of the foreigner

THE "warning" referred to above has aroused considerable discussion in the German technical press One of the main points brought out in this discussion is that German industry as a whole, does not avail itself of the help of chemical science nearly so much as it should do, and there are many important branches of industry which might profit from a greater appreciation of applied chemistry, but the chemist is almost wholly ignored or is given a quite subordinate status This may sound a little strange for the view has hitherto been prevalent in Great Britain that at least in Germany the chemist was fully appreciated Be this as it may, another point emerging from the discussion in the press is that it is not altogether the fault of industry if the chemist is somewhat neglected in some branches of manufacture It is urged that his training is often at fault it is too academic Others consider that the main difficulty is that too many leave the universities without troubling to take their degrees However, the warning does not so much apply to these as to the men who take high places in chemistry and are yet unable to find employment It may be that many of them in view of their supposed qualifications, want too high salaries to begin with, and German industry in its present rather poverty-stricken condition cannot afford high outlay on scientific research As in Great Britain, the mistaken policy is often adopted of starting any retrenchment in the research department

TWENTY-FIVE years ago, in Lahore the Society for Promoting Scientific Knowledge was started by medical college students, supported later by professors and local medical practitioners, to do something towards educating the public in matters scientific, and in particular in matters of public health, sanitation and household hygiene It was no light task when all but the promoters appeared apathetic, by steady persistence, however, recognition and popularity followed, by local subscriptions and a grant from the Punjab Government, the S P S K became firmly established, with its own large public lecture hall Branch societies were opened at various places in the Punjab and even in Kashmir By the publication of a magazine and many leaflets in the vernacular, numerous public lectures and conversaziones the Society does good work the Society's functions are well attended by all classes with undoubted beneficial results The future of the Society is full of promise, for it has enlisted the support of the most prominent government officers and citizens, with His Excellency the Governor of the Punjab as patron The Society's silver jubilee was celebrated by a conversazione in the Chemical Laboratory of the University of Lahore and the Biological Laboratories of the Government College and a public meeting in the Society's Hall

AT the recent conversazione of the Royal Society, exhibits of several types of steel containing nickel and chromium and offering a high resistance to corrosion were exhibited The specimens shown by Sir Robert Hadfield included two new alloy steels which are notable for their permanence on exposure to the atmosphere and to fresh or salt waters differing from the ordinary non-rusting chromium steels in being independent of heat treatment The heating and cooling curves indicate a complete absence of critical points, and no change of phase is detected by microscopical examination, so that the structure remains homogeneous whatever be the heat treatment to which the steel is subjected Riveting and brazing consequently have no effect on the capacity of the alloy for withstanding corrosion The exhibit included turbine blades and test specimens showing the mechanical properties of the steel at atmospheric temperatures and at temperatures up to 650° C under prolonged loading, showing the absence of creep Specimens were also arranged to illustrate the history of the attempts to improve the resistance of iron and steel to corrosion rusting and scaling

PROF RAYMOND PEARL has endeavoured to estimate statistically the relation, if any, between the number of doctors per unit of population and the death rates observed for the same population (Journ Amer Med Assoc, 1925, vol 84, p 1024) It appears that for the thirty-four States of the United States investigated there is no significant difference in the mortality rate of a community in 1920, whether that community had few or many doctors per unit of population Two morals suggest themselves from this result The first is that perhaps the chief social and human value of the physician is in alleviating suffering, rather than in preventing death, at which last task he must in every case ultimately fail The second is that while there is a great difference between good doctors and poor doctors in respect of the result of their activities, there is no significant difference between a good doctor and no doctor at all!

WE learn from *Science* that the new building and laboratories of the Marine Biological Laboratory Woods Hole, Massachusetts, were opened on July 3

Mr C R Crane, president of the board of trustees, made himself responsible for the cost of the new building beyond the original estimate of 100,000*l* In all a sum of 280,000*l*, including gifts from the Rockefeller Foundation, the Carnegie Corporation, Mr John D Rockefeller Jr, and the Friendship Fund, was collected, and 180 000*l* of this has been invested for endowment Previous to this extension the assets of the Laboratory were valued at 100,000*l*, so that the trustees now have a property worth nearly 400,000*l* to administer The new building provides for an extension of the library, a lecture hall, offices, research rooms supplied with fresh and salt water for aquaria, photographic rooms, and so on

THE report of the Valletta Museum for 1923–24 is largely taken up with accounts of excavations on prehistoric, Phœnician, and Roman sites Two finds are particularly noteworthy Neolithic debris at Hagiar Kim yielded a statuette in baked clay, consisting of the head and neck of a figure with horns coiled twice round the ears The figure may be that of a ram but is believed to be more probably human it is 43 mm high At Mgar, where are, or were, extensive megalithic ruins was found a model of a megalithic building made of globigerina limestone The model which is 47 mm long and 33 mm high represents an oval building of slabs on end with pillars between them, and roofed by eight horizontal slabs The entrance is through a trilithon with a high sill

OF the making of journals there is no end The increase in the number of biological journals since the War has been surprising, yet they nearly all appear to fill a useful place in the development of science The latest addition is called the *Archiv für experimentelle Zellforschung besonders Gewebe uchtung* (*Explantation*), and aims at covering the field of tissue-culture microdissection and similar experimental work with the cell The general editor is Prof Rhoda Erdmann of Berlin, and she is assisted by fourteen investigators in various countries whose names are connected with these fields of research Papers are accepted in English, German, French, and Italian The first number which we have recently received, begins with an extended Italian paper by G Levi on the conservation and loss of independence of tissue cells in culture Other papers deal with cultures of heart tissues and sarcoma cells M Thielman describes culture experiments with stomatal plant cells, and Albert Fischer describes an apparatus for extracting the juice from parenchyma tissues The number concludes with a list of the papers which have appeared in this field in the years 1920–1924, compiled by the editor and covering thirteen pages It is intended later to compile all the literature from the beginning of tissue culture Any authors whose papers are not included in this list are asked to send the titles to the editor at Nassauische Strasse 17II, Berlin-Wilmersdorf This number of the journal contains 144 pages and one coloured plate It is published by Gustav Fischer, Jena, and the price is 8 gold marks

THE autumn meeting of the Iron and Steel Institute will be held at the University, Birmingham, on September 9-11, under the presidency of Sir Frederick Mills, Bart The programme includes papers on blast-furnace practice in India high-frequency induction furnaces, properties of single iron crystals, moulding sands, and on various iron and steel equilibrium systems Cheap travelling facilities are being granted by the railway companies

THE Royal English Arboricultural Society has arranged for a number of visits to forests in different parts of England and Wales during the month of August The visits are open to all who are interested in forests and woodlands The summer meeting of the Society is being held at Norwich during the first week of September Particulars can be obtained from the secretary Mr E Davidson, Estate Office Haydon Bridge, Northumberland

THE Minister of Health has appointed the following committee "to draw up a practicable scheme of post-graduate medical education centred in London" —The Minister of Health (chairman) Sir Arthur Robinson, Lord Dawson of Penn, Sir Humphry Rolleston, Bt, Sir John Bland-Sutton, Bt, Sir Thomas Horder, Bt, Sir George Newman Sir George Blacker, Dr R A Bolam, Dr H G Dain Mr H J Paterson, Dr J Parkinson Dr H L Eason, Prof Hugh Maclean, Mr A E Webb-Johnson

AT a meeting of the Vienna Academy of Sciences on June 12, Dr Oswald Redlich was re-elected president, and Dr Richard Wettstein vice-president Dr William Exner of Vienna and Dr Waldemar Chr Brogger of Oslo were made honorary members Dr Niels Bohr of Copenhagen, Dr Max von Laue of Berlin, and Dr Eugen Korschelt of Marburg have been elected foreign corresponding members The following awards were made the Lieben prize to Dr L Meitner for publications in the *Zeitschrift für Physik* on β and γ rays of radioactive substances, the Haitinger prize to Dr R Kremann for work on the electrolysis of metal alloys, and also to Dr L Moser for work on quantitative analysis and the purification of gases The prize of 1000 golden krones for a work on the physiology and pathology of the effect of high altitudes offered by the Semmering Alpine Sanatorium Austria, has not been awarded, but is offered again The prize is intended for Austrians, but foreigners will be considered if their work is done in Austria Papers should be sent to the Kanzlei of the Akademie der Wissenschaften, Wien I, Universitatsplatz 2, before December 31 of this year

THE Smithsonian Institution at Washington has just issued its annual Exploration Pamphlet (Smithsonian Miscellaneous Collections vol 77 No 2), of which rather more than half is devoted to archæological and ethnographical investigations in the field during the past year An expedition to China sent out under the joint auspices of the Freer Gallery of Art of the Smithsonian, and the Museum of Fine Arts Boston carried out successful investigations at I Chow, in the province of Chihli and at several

localities in the province of Shensi In these regions the sites of two ancient cities were traced and many mounds inspected The first actual excavating was done at Yu-ho Chen, in the province of Honan, where two tombs of the Han Dynasty (206 B C to A D 221) were opened Cultural objects from prehistoric times to the Han period were brought to light, including chariot-fittings mirrors and arrow-points of bronze one or two gold rings, much pottery, and many other interesting objects In Florida Dr J Walter Fewkes excavated the large Weeden Mound, and brought to light a large collection of Indian skeletons pottery artifacts, and other material of prehistoric origin This mound was found to consist of two distinct layers a lower layer containing crude undecorated pottery and an upper layer which produced decorated pottery each piece of which was "killed" or punctured to allow the escape of the spirit of the bowl In Alabama he uncovered several interesting mounds including one which would shortly have been submerged by the back water from the Wilson Dam at Muscle Shoals

ONE of the principal features of the celebration at Amsterdam on October 25, 1924 of the jubilee of the foundation of stereochemistry by Le Bel and van t Hoff, was the delivery of a masterly review by Prof Walden of Rostock (formerly of Riga) of the progress of stereochemistry during the intervening fifty years This review was printed in the Amsterdam *Chemisch Weekblad* of January 24 1925, but has been appearing in a revised form in *Die Naturwissenschaften* (April 10-May 1) This revision has made it possible to include references to the literature published up to the end of 1924 The review is therefore as noteworthy for its completeness as for the masterly way in which the vast range of material has been marshalled into a well-ordered scheme

APPLICATIONS are invited for the following appointments, on or before the dates mentioned Two or three assistant superintendents in the Geological Survey of India—The Secretary to the High Commissioner for India 42 Grosvenor Gardens London S W 1 (August 15) A research officer in crop and animal husbandry under the Ministry of Agriculture for Northern Ireland—The Secretary to the Ministry, Wellington Place, Belfast (August 17) An assistant in the Pathological Laboratory Harpenden, of the Ministry of Agriculture and Fisheries—The Secretary to the Ministry, 10 Whitehall Place, London, S W 1 (August 29) An assistant at the National Physical Laboratory to act as librarian and editor of publications—The Director, National Physical Laboratory Teddington (August 31) An assistant in the department of natural history and zoology of the University of Edinburgh — The Secretary of the University (September 25)

Our Astronomical Column

THE COMPANION OF SIRIUS — Prof Eddington announced, at a recent lecture to the Cambridge Philosophical Society and the members of the International Astronomical Union, an interesting result arrived at by Dr C E St John at Mount Wilson Observatory It has been found possible to photograph with the 100-inch reflector the spectrum of the companion of Sirius separately from that of the bright star It is of type F and therefore its surface brightness is greater than that of the sun, from its very feeble luminosity its diameter is concluded to be about that of the planet Uranus, while its mass is three-quarters of that of the sun Hence its density is enormously great and it is a favourable object for Einstein's third astronomical test—that of the spectral shift Single stars do not avail for determining this since we cannot separate radial velocity from Einstein shift But in this case, differential measures from Sirius are possible, the correction for orbital motion being well known

The result is very striking after allowing for orbital motion, an Einstein shift equivalent to a radial motion of 21 km /sec was found This was tested on a large number of lines, so that it appears to be well established The result is very important in two ways First, it gives a confirmation of the Einstein spectral shift stronger than we can obtain from the sun, where its value is only 0 6 km /sec an amount that it is difficult to separate from pressure effects or systematic surface drifts Secondly, it affords strong evidence of the truth of Prof Eddington's conclusion, arrived at last year that atoms when stripped of their outer electrons are capable of being packed to extraordinary density without departure from the gaseous state, the density deduced in this case is hundreds of times that of the metals Details of the investigation will be awaited with interest, but the well-known skill of Dr St John justifies us in receiving it with considerable confidence

AN INDIAN ASTROLABE —In the *Heidelberger Akten der von-Portheim-Stiftung* (No 13) (Heidelberg Carl Winters Universitats Buchhandlung, 1925 4 gold marks) Dr Josef Frank and Dr Max Meyerhof have published a paper, "Ein Astrolab aus dem Indischen Mogulreiche," which gives a lengthy description of an astrolabe in the Kestner Museum at Hanover In a bibliographical introduction the authors give a list of four manuscripts and many printed memoirs on astrolabes consulted by them not including those quoted in the course of the paper Next follows a description of the instrument, which is of medium size, having a diameter of 84 mm, and a short account is given of the various problems of spherical astronomy and astrology to which the instrument can supply approximate solutions For this purpose every planispherical astrolabe is furnished with a number of circular plates which fit in the rim of the "mother" or shallow circular trough on the front of the instrument On these plates are engraved for various latitudes stereographic projections of the principal circles of the celestial sphere The instrument in question has plates for the latitudes 18°, 21° 40′ (Mecca), 24° 27°, 32°, 35°, 39° 37′ the last one being probably for use at Bokhara An inscription on the triangular bracket carrying the ring whereby the instrument is suspended, shows that it was made in A H 1018 (A D 1609) at Lahore by two brothers, sons of Isa b Allahdad, and belonging to a family of astrolabe makers Other inscriptions mostly in Persian, give 37 names of towns (with longitudes and latitudes), chiefly in the Mogul Empire but it is not unlikely that these inscriptions are due, not to the maker, but to a somewhat later owner

Research Items

RELIGIOUS BELIEFS IN THE SIMLA HILLS.—Mr. H. A. Rose has communicated to the June and July issues of the *Indian Antiquary* a number of legends of the *deotas* or godlings of the Simla Hills, collected mostly from the district of Khumhârsain by Pandit Sukh Chain. The legends cover seven families or groups, and in most cases give an account of the origin of the godling and its cult. In a number the serpent appears. Kot Ishwar, for example who originated in the temple of Durga at Hat Koti and had been imprisoned by the magic of the Brahmans on account of his oppression of the people, in order that he might be thrown into the river escaped and troubled the people in the form of a serpent, sucking milk from the cows. The same story of taking the milk from the cows in the form of a serpent is told of the *deota* Marech of Malindi. Kalû, the eldest of five brothers and a hermit, when he died became a snake living on Tikkar Hill who devoured men. He could draw people into his mouth from afar by his breath. Others of the godlings had a fondness for human flesh, and demanded human sacrifice. Dithû's favourite meal was a woman's breast, of which he ate one every day. He was arrested on the order of Kot Ishwar, and not released until he had sworn not to touch human flesh again.

SCULPTURED STONES FROM GORGONA, SOUTH AMERICA.—In *Man* for July, Mr. Hornell continues his account of the archaic sculptured rocks found on the island of Gorgona by the *St. George* Expedition. On a second group of rocks the incised figures were very numerous, but greatly worn. The central boulder of the group is thickly set with small cups from an inch to an inch and a half in diameter, and half an inch in depth. At the ends are the figures of a frog and a bird, and on one side is a triangular axe lashed to a haft. On a ridged stone near by is a rude human face and a complicated, but symmetric, design of superimposed groovings. These designs appear to have been cut with stone implements, and a number of such implements have been found together with fragments of pottery. Embedded in the beach were numerous fragments of large stone troughs. One of four boulders with relatively modern engravings showed a head with a peculiar form of tailed cap which points to an Indian, possibly Inca, origin. Later investigations on a second visit, suggest that the stones described in the previous communication were the sacred place of the island while the second is probably secular. Two settlement sites were dug and showed that the inhabitants probably lived in pile-dwellings.

GEOLOGY OF THE TAUNGS STRATA.—It will be remembered that the limestone block from which Prof. R. Dart chiselled out the fossil skull of *Australopithecus africanus* was brought to him by his colleague, Dr. R. B. Young, professor of geology in the University of the Witwatersrand, Johannesburg. On April 20 last Dr. Young read a paper to the Geological Society of South Africa on the cliff-limestone at Buxton, seven miles to the south-west of Taungs from which the famous fossil was quarried in November 1924. From this paper (Trans. Geol. Soc. S. Africa, 1925, vol. 28, pp. 55-67) we learn that the cliff-limestone at Buxton was deposited at the eastern edge of the Kaap plateau by streams and springs issuing from the dolomitic limestone of that plateau. Dr. Young found that calcareous deposits were still being formed at various points along the eastern escarpment, and although he refuses to hazard an opinion as to the geological age of the cliff-limestone exposed in the quarry at Buxton, it is clear that he does not think it can be older than the pliocene and may be later. In this recent limestone deposit numerous and extensive caves and passages formed, many of them communicating by fissures with the surface of the plateau. The caves, when exposed on the face of the quarry at Buxton, were found to be filled by bedded sands, similar in texture to those of the Kalahari. Dr. Young sums up his opinion regarding the antiquity of Australopithecus in a concluding paragraph thus: "This conclusion applies to the skull of Australopithecus. The position in the quarry face from which it came . . . was a few feet to the left of the body of loose sand already described in detail. The limestone in which it was embedded was full of reddish sand and, as previously shown, probably formed part of the filling of an underground passage in the limestone. The loose sand had all the appearance of being water deposited, and possibly the skull was washed in from the surface. I may mention that the latter event seemed to me the more probable when, above the limestone cliff at Thoming, I came on an isolated, complete, and partly cleaned skull of a baboon which had obviously been removed along by surface water and might easily be washed into any opening in the rock." Dr. Young also found that baboons still frequent caves along the eastern escarpment of the Kaap plateau.

THE LAVALA WEED IN INDIA.—The Lavala weed, *Cyperus rotundus*, probably reduces the crop yield in many fertile districts in India by 25 to 30 per cent., and in view of the great loss thus incurred S. B. Ranade (Mem. Dept. Agric., India, 13, No. 5) has fully investigated the life history of the plant with the view of ascertaining its most vulnerable points and the best means of effective eradication. Enormous quantities of "seeds" (calculated at fifty-four million per acre) are produced throughout the year, particularly in July and October, and prevention of flowering is therefore of paramount importance. Lavala is of geophilous habit, and establishes a subterranean tuber system as soon as the first aerial shoots have appeared but not before. Consequently, if germinating seeds or tubers can be prevented from putting up aerial shoots, by means of judicious cultivation and weeding, it is possible to prevent fresh colonies from being formed. Established colonies in badly infested land penetrate three feet deep in the soil, and though repeated removal of the aerial parts at short intervals will eventually exhaust the tubers the process is very slow. Experiments indicate the value of bringing the tubers to the surface by deep ploughing, as tubers exposed on the surface of the soil in hot weather, or not deeper than three inches deep in dry soil, are killed in eight days. The use of certain smother crops is also successful, sann hemp distinctly reducing the numbers of tubers in the soil, though other methods of covering were less useful. The best practical method of treatment seems to be continuous hot weather cultivation, in order to expose as many tubers as possible to the air, followed by a thick green manure crop ploughed in early, and again succeeded by a second dry season's continuous cultivation. Once clear, no difficulty should be experienced in keeping the land clean from further infection. The article includes details of many laboratory experiments yielding much information with regard to the propagation of Cyperus by tubers and on the effect of spraying with various chemicals.

HYDROGEN-ION CONCENTRATION AND CELL DIFFERENTIATION IN PLANTS.—Dr. H. Pfeiffer of Bremen pub-

lishes a long and very interesting paper (in German) in vol. 24, No. 2, of the *New Phytologist*, in which he records his observations upon the relation between the P_H of the developing tissue and the process of differentiation, his data being obtained from studies of the secondary phloem of the dicotyledon. He has studied the crystallisation of calcium oxalate from solutions of different P_H and points out that the monoclinic crystals (raphides) are deposited at low (acid) P_H values, whilst the tetragonal (sphæraphides) or amorphous forms are deposited from neutral or alkaline solutions. Pfeiffer then employs indicators upon plant sections and concludes that this factor of P_H is probably of importance in determining the form of the crystalline deposit laid down in the living cells of the secondary phloem and cortex. Dr. Pfeiffer further shows that thin-walled cells appear to be associated with a low P_H of the tissue during development, whilst in tissues that are more alkaline during development thick cellulose deposits are the rule.

INDIAN AMPULLARIIDÆ.—In 1920 the Zoological Survey of India, then under the Directorship of the late Dr. T. N. Annandale, began a series of small monographs on the genera of the freshwater gastropod Mollusca of the Indian Empire as a basis for the accurate determination of those species, if any, that acted as the intermediate hosts of internal parasites inimical to man. The latest and in some respects best of these is a "Revision of the Indian Ampullariidæ," by Dr. B. Prashad (Mem. Indian Mus., 8, No. 2). The author, who accepts Dall's classification for the family published in 1904, recognises two genera as being present in India—Pila of Bolten, to which belong the common forms found in the plains, and Turbinicola of Annandale and Prashad, embracing the hill-stream species. Nine species of the former, including *P. robsoni* n. sp., and two of the latter are carefully and adequately described almost entirely from the conchological aspect, and for the first time in the series a properly worked out synonymy is prefixed to each, thus greatly enhancing the value of the work. The three plates of shells prepared from untouched photographs by the artists of the Survey well deserve the commendation bestowed upon them by the author.

GEOCHEMICAL DATA.—Those interested in the study of rocks and minerals, more especially in relation to geochemical processes, will welcome the recently published fifth edition of Dr. F. W. Clarke's "Data of Geochemistry" (Bull. 770, U.S. Geol. Surv., 1924). The first edition of this very useful bulletin was published in 1908, being followed by later editions in 1911, 1916 and 1920. The work has been revised for the present edition, which, with its 841 pages, has ten more than the previous one. The author does not pretend that the book is an exhaustive monograph on geochemistry. He modestly claims that it presents to the reader a critical summary of what is now known about this subject, and serves as a guide to the more important literature. He gives little attention to merely speculative matters, preferring, in accordance with the title of the book, to set out the available data. These relate not only to rocks and rock-minerals, but also to coal, petroleum, and metallic ores. Chapters are given to the chemical elements, the atmosphere, lake and river waters, ocean waters, well and spring waters, saline residues, volcanic gases and magmas. The book is a model of accuracy and terseness. Probably none of the other publications of the United States Geological Survey has attained such a wide and well-deserved popularity among students of chemical mineralogy and geology. It is already so well known that it seems almost superfluous to recommend it to any one interested in the data of geochemistry.

THE ORIGIN OF THE RYDBERG SERIES.—In *Die Naturwissenschaften* of July 3, Prof. A. Landé of Tübingen raises the question, "Why do the chemical elements fall into periods of 2, 8, 8, 18, 18, 32?" A novel answer is given to this question since, by taking into account the four series of quantum numbers (n, K, J, m) indicated by the analysis of spectra, it appears that the total number of options is 2, 8, 18 and 32 for the cases in which $n = 1, 2, 3$ and 4. There is therefore only one electron for each option, and no two electrons need be assigned the same series of four quantum-numbers, even in the case of the more complex atoms. This classification of orbits is, however, different from that which was in vogue a year or two earlier, and depends on assigning to K the quantum numbers $\frac{1}{2}$, $\frac{3}{2}$, $\frac{5}{2}$, etc., instead of the integers which were used at an earlier stage.

MONOMOLECULAR FILMS ON WATER.—A paper on this subject by W. D. Harkins and E. H. Grafton, appears in the May issue of the Journal of the American Chemical Society. The areas occupied in films by the molecules of various hydroxy-derivatives of benzene were determined by surface tension measurements of their solutions. The results indicate that while phenol, pyrocatechol, resorcinol and pyrogallol give "condensed" films (*i.e.* films of low compressibility), these films are nevertheless not "closely packed." All the substances investigated give expanded or "gaseous" films at lower concentrations of the solutions. It is probable that the hydroxyl group turns towards the water while the phenyl group is on edge or on end above it. With *o*-hydroquinol, however, both hydroxyl groups are immersed in the water, while the phenylene group remains on the surface.

TESTING RADIO-TRANSMITTING ANTENNÆ.—A serious difficulty in connexion with experimental research on the best shape of the antennæ used in radio communication is that in practice the radiating systems used are very elaborate and costly. Once these systems are erected their heavy initial cost makes it imperative that they be operated commercially as soon as possible, and very little time is available for scientific investigations. The research bulletin issued last May by the University of Illinois dealing with the question as to whether the action of antennæ can be investigated by means of models is therefore a timely one. The author, Mr. J. Tykociner, adopts two theorems proved by Max Abraham about thirty years ago. They are that if we have two geometrically similar oscillators, their natural periods are proportional to the lengths of their respective segments, and they also have equal logarithmic decrements. The assumption is made that the ohmic resistance of the conductors is zero; the decrement is supposed to be due, therefore, to the radiation resistance. A proof is given that the radiation resistance of a model antenna is approximately equal to that of the original antenna. The smaller the model, therefore, the higher becomes its fundamental frequency as compared with that of the real antenna. Full instructions are given for making model antennæ. It is shown that the working characteristics of full-sized antennæ can be predicted with a maximum inaccuracy of about one per cent. by this method. Exceedingly short waves are used in the experiments, their wavelengths being less than 10 metres. They do not disturb, therefore, commercial radio traffic, and the errors due to the interference of commercial radio stations are negligibly small.

Filter-passing Viruses in Disease

AT the Bath meeting of the British Medical Association a discussion on the filter-passing viruses occupied the first day of the meeting of the Section of Pathology and Bacteriology The discussion was opened by Dr W E Gye Dr Gye criticised the expression "filter-passing viruses," which is generally used to include certain viruses which have hitherto not been proved to be filterable The use of the term "filterable viruses" though convenient, has at present no real significance His own experience has been particularly with Rous's chicken sarcoma, and even with this virus, filtration can only be conducted if certain experimental conditions are observed If the tumour emulsion be insufficiently diluted, and if distilled water be employed instead of saline, the filtration is much more difficult, and it is seldom that an infective filtrate is obtained By using a small volume of saline, or by using distilled water as a diluent, one obtains a viscous solution of mucin and nucleo-protein which will not pass the filter readily The hydrogen ion concentration of the liquid also affects the rate of filtration, within limits not yet exactly determined acidity increases the difficulty of filtration and alkalinity makes the process easier The properties of the liquid in which the virus is suspended thus play an important part in the results of filtration

A further important factor in filtration is the adsorptive capacity of the filter Under certain conditions the filtrates of the infective material in Rous's sarcoma failed owing to the adsorption of the virus on the surfaces of the filter The only method readily available by which the particulate character of viruses can be tested is that provided by the centrifuge In the case of Rous's sarcoma long centrifugalisation at 8000 revolutions a minute at least, is necessary to obtain a definite difference in the infective actions of the upper and the lower layers There is an urgent need for a machine which will spin at a higher speed with safety and is so constructed that fluids can be spun without running the risk of contamination It is very improbable however that we shall ever get a centrifuge with which it will be possible to spin out completely an organism of the size, roughly of 0 1 μ

The identification of the filterable viruses by staining methods is beset with fallacies and the results obtained up to now have proved in the main disappointing The microscope proved of very little value except in revealing contaminating microbes It is possible that, with increasing knowledge of the ultramicroscopic organisms, we shall find that the doctrine of fixity of form holds here as well as with ordinary microbes With regard to the cultivation of the filterable viruses, each virus must be considered by itself The virus of pleuro-pneumonia is apparently the only organism of this group that grows readily on artificial media The production of cloudiness in Noguchi tubes, which has been put forward as a proof of culture, so far as chicken sarcoma is concerned is entirely erroneous

The animal test provides the final proof of the presence of the organism in an inoculum The difficulty of microscopic investigation in this field makes us fall back in a very special way upon animal experimentation It is because ordinary laboratory animals are not susceptible or only slightly so to human filterable viruses such as measles or influenza that such small progress has been made We shall be compelled to work at animal diseases if we want to discover a method of handling and identifying the very small microbes This will, however, involve great expense and is open only to those who have ample funds behind them

In addition to his opening address (which was circulated but not read) on the more general aspects of the filterable viruses, Dr Gye also discussed some aspects of the recent work he has done in collaboration with Mr J E Barnard on cancer The mere conjunction of host and parasite does not necessarily produce disease There are accessory factors that must be searched for Some years ago Dr Gye and Dr Cramer investigated the accessory action of certain chemical substances in the production of gas gangrene, and Dr Gye had formed the opinion that the conception of disease as being due to the conjunction of living organisms involving a non-living factor was capable of further development In this way he was led to his experiments on cancer Any theory of cancer had to provide an explanation of its particular specificity both as regards the animal species the tumour is able to attack, and the type of growth produced Yet cancer can be looked at from some points of view as one homogeneous specific disease, which has probably some common cause underlying it The difficulty of obtaining a theory of cancer capable of reconciling the 'specificity" of new growths with the general properties they hold in common has been overcome in Dr Gye's opinion, by his experimental work on Rous's sarcomas

The infective filtrates of ground-up Rous's tumours contain not the virus only, but also an accessory substance or substances which are necessary to produce the disease The accessory substances are responsible for the more specific peculiarities of the tumour, such as its histological structure and the susceptibility of certain animals to it

The actual virus is probably the same in every case and by means of prolonged spinning in a centrifuge, the virus may be obtained apparently free from the other factors By suitable treatment with chloroform the virus can be destroyed without affecting the "specific factor Neither the virus nor the accessory factor is separately able to produce sarcoma The fact that "virus factor from human carcinoma is able to produce sarcoma in the chicken if reinforced by the 'non-virus' or 'specific factor from Rous's tumour brings the infectious sarcomas into line with the mammalian tumours, which up to now have been considered by most authorities to be non-infectious

Mr J E Barnard followed Dr Gye with an account of the optical part of the work they have done on cancer He dwelt on the limitations of microscopical research into filter-passing viruses, and stated his opinion that the present dark ground illumination apparatus such as is used at the National Institute for Medical Research is of such perfection that further improvement in direct microscopy upon present lines cannot be expected The method which has proved so valuable in his and Dr Gye's work depends upon the use of an apparatus by which the object can be focussed in visible light and by a mechanical device can be refocussed in any desired wave-length and thus a photomicrograph is obtained using light with a very short wave-length What is believed to be the virus of cancer has thus been photographed, and what are considered to be phenomena of growth were seen in the preparations The real difficulties in the work depend upon biological rather than physical considerations The material is, in fact, more important than the apparatus, and much depends upon the absorptive capacity for light of the media and

of the virus itself The study of the absorption of the material will be the key of further optical improvement in microscopy

Dr M H Gordon dealt with the problem of the filter-passing viruses in the light of his experimental work on vaccinia and variola These diseases are particularly suitable for the preliminary attack on the problem since a small animal is available that is susceptible to the virus, and the lesions produced by the virus are so characteristic that there is no likelihood that they will be mistaken for accidental lesions In his work Dr Gordon decided that since the cultivation of the virus and any attempts to make it visible by microscopic means are beset with difficulties the most promising line of attack is by the methods of immunity Vaccinia also satisfied the criterion of particulate matter, and centrifugalisation can separate infectious material into layers of varying infectiousness Vaccinia is filterable, but only with special precautions *e g* after previous treatment of the material with trypsin

Active immunity to vaccinia can be produced not only by normal living virus but also by means of heated attenuated virus In rabbits a passive immunity can also be transferred Agglutination and complement fixation experiments have been done with the virus and its immune serum Agglutination of the virus is easily visible with the naked eye or with a hand lens Preparations of the agglutinated material show objects which bear a close resemblance to those figured by Dr Gye and Mr Barnard in their paper on cancer The use of the agglutination method has given some interesting results Material from confluent smallpox and from the so-called Alastrim absorbs the agglutinin in the same way as the homologous virus of vaccinia From the point of view of agglutination, the close relationship, if not identity, of these three diseases was confirmed Dr Gordon finds a very striking susceptibility of vaccinia virus to potassium permanganate, which is more destructive than the customary disinfectants Potassium permanganate in 1 in 100,000 dilution destroys the virus in a short time This curious susceptibility of the virus may indeed to some extent, explain the result credited to this drug in the treatment of smallpox Dr J E McCartney stated that in the case of herpes virus he has been unable to separate virus from its suspension fluid by means of spinning This he ascribed to the activity of the virus at much greater dilutions than that of the sarcoma or vaccinia viruses

As was to be expected from the great interest that has recently been taken in the action of light and other physical agents in medicine, this subject was also prominent at the Bath meeting Three discussions dealing with different aspects of this subject were included in the programme Prof S Russ opened a discussion on the pathological basis of treatment by radiation with a general statement of the physical problems involved Dr E T Strangeways gave an account of experiments on the effect of X-rays on the division and development of tissue cells grown *in vitro* He has been able to kill chick embryos while in the shell with X-rays, though after death of the embryo as a whole, successful tissue cultivation could still be made

Miss M E Hume discussed the action of ultra-violet light on rickets, and the relation of light effects due to vitamin A Dr Canti described the action of radium on the mitosis of cells in human carcinoma

In the Section of Therapeutics Prof W E Dixon opened a discussion on the therapeutic action of light, and in the Section of Public Medicine, Prof Leonard Hill dealt with the influence of sunlight and artificial light on health In all these communications there was the healthy sign that this branch of medicine which a short time ago was in an empirical state, is now rapidly being co-ordinated on a scientific and experimental basis Prof Russ's concluding remarks seem to sum up the present position with regard to this branch of experimental medicine "There is nothing so depressing as being told that we are only at the beginning of the subject I do not think that this is the case, but rather that we are well in the middle of it"

Strong Electrolytes

A SERIES of papers on the activities of strong electrolytes by G Scatchard, appears in the Journal of the American Chemical Society for March The activity of hydrochloric acid was obtained from measurements of the E M F of the cell $Pt(H_2)/HCl$ $AgCl/Ag$ The hydrogen electrode was of a rocking pattern suitable for use in a thermostat and simplified by the absence of a liquid junction The activity coefficients obtained agree with those calculated from Randall and Vanselow's freezing-point measurements the values at low concentrations are consistent with Debye and Huckel's limiting equation, the theoretical value of the constant in that equation being retained The activities of potassium sodium, and lithium chlorides are also considered, the existing data are compared and discussed in the light of Debye and Huckel's theory

Individual ion activities have always been calculated through one of three assumptions namely (1) that the activities of the ions in a uni-univalent electrolyte are equal (2) that the above is true in the case of potassium chloride, and that the activity of an ion depends only upon the total ionic concentration and not on the ions with which it is associated, (3) that the saturated potassium chloride bridge eliminates liquid-junction potentials Assumptions (1) and (2) are in general incompatible assumption (3), however, is quite distinct and is compared with the first two by G Scatchard by measuring the E M F's of the cells, $Pt(H_2)/HCl$, $AgCl/Ag$ and $Hg/HgCl$ $KCl(sat)/HCl$ $AgCl/Ag$ the latter containing a flowing junction

The results indicate that assumption (2) above is correct and that the saturated potassium chloride bridge gives a liquid-junction which does not vary with the acid concentration The liquid-junction potential alters slightly on stopping the flow In more concentrated solutions the chloride ion appears to attain a maximum activity, whilst that of the hydrogen ion appears to drop to a minimum value The results obtained enable certain single electrode potentials to be accurately calculated

From a series of papers by H S Harned on the subject in the same issue of the Journal of the American Chemical Society the activity coefficient and the vapour pressures of the solutions are calculated from the E M F of the cell $H_2/NaOH(c_1)/NaHg/NaOH(c_2)/H_2$ The activity coefficient of potassium hydroxide is greater than that of sodium hydroxide at concentrations greater than 0 05 molar In the presence of sodium chloride the logarithm of the activity of the hydroxide (concentration less than 0 5 molar) is a linear function of its concentration at constant total molality For potassium hydroxide in potassium chloride solution the activity coefficient is greater than that of sodium hydroxide in a sodium chloride solution when the hydroxides and salts are at the same strength W Lucasse records the activity coefficients and transport numbers of the alkaline-earth chlorides in the same journal

The Sixth International Congress of Photography

DURING the period June 29–July 6 there was held in Paris an International Congress on Photography, the purpose of which was to consider questions of standardisation in both pure photography and cinematography The last Congress was held in Brussels in 1910, and was to have been succeeded by a Congress in London in 1915, but unfortunately the War intervened

One of the reasons for holding the Congress this year in Paris was that it is the centenary of the discovery—according to French claims—of photography by Nicephore Niepce, at the same time a plaque to the memory of Daguerre was unveiled Attending the Congress were delegates from the United States, Belgium, England, France, Germany, Holland, Italy, Japan, Spain, and other countries It was especially noticeable that there was nothing wanting in the cordiality with which the Germans were received, political questions were entirely put aside, it being realised that all the members had met for the furtherance of a common cause Discussions were carried on in English, French, and German

The Congress was opened on Monday afternoon, June 29, by Prof Fabry of the Sorbonne, who is at the same time the president of the French Photographic Society One delegate from each of the countries represented was elected as vice-president, and these presided in turn at the various sessions The general arrangements were in the hands of MM Clerc, Labussiere, and Lobel

For some time previous to the Congress an English committee, appointed by the Royal Photographic Society, had been at work in drawing up recommendations with respect to a standard light source, exposure mechanism, development and subsequent treatment the measurement of density, and the interpretation and statement of results These recommendations were submitted to the Congress committee in sufficient time for them to be translated into French and German and circulated among the members Recommendations were also received from the Optical Society of America with respect to the standard light source It is significant that these recommendations formed the main basis of discussion Agreement was arrived at between the various interests represented and definite resolutions, embodying most of the recommendations of the English committee were passed, but will not come into force until after a period of six months The cinematography section was also able to harmonise the various points of view held by the different countries represented An international executive sub-committee was appointed, with M Clerc as secretary, and it was resolved that the next Congress should be held three years hence, and that the place of meeting should be, if possible, in London

In addition to the various meetings of the sections there were functions of a less arduous character, including a reception at the Hotel de Ville de Paris by M Guillaumin, President of the Municipal Council, and a soiree, in the large amphitheatre of the Sorbonne, to commemorate the centenary of the invention of photography, at which the President of the French Republic, M Doumergue, was present A visit was made to the works and studios of M Gaumont, and there were motor-car excursions to Ermenonville Chaalis, and Senlis, and to the forest and chateau of Fontainbleau The actual proceedings of the Congress were terminated on Saturday, July 4 by the usual banquet T SLATER PRICE

Fishery Investigations

THE Ministry of Agriculture and Fisheries has recently issued a report on sea fisheries for the years 1919–23 the last one (for the period 1915–1918) being published in 1920 This is a great pity because both reports have been so very interesting The 1920 report gave an engrossing account of the part played by British fishermen in the War, while the present one (H M S O 1925, 3*s* 6*d* net) deals in an equally agreeable way with the gradual settling down towards normal conditions of the sea-fishing industry Statistical tables summarising the catches made and other numerical results of the Ministry's work, have been issued each year, and the report now available discusses in a general way, the information that has been collected There is a very good summary of the scientific investigations made during the post-War years, and there are a number of clear financial statements showing the cost of the various kinds of work, administrative, developmental and scientific, undertaken by the Ministry

Three parts of the Ministry's publication, " Fishery Investigations ' have recently been published No 6 vol 6, Ser II " The Annual Cycle in the Life of the Mature Cod in the North Sea," by Michael Graham and collaborators deals with the investigations, biological and statistical, made during the last few years (H M S O, 1924, 13*s* net) No 2, vol 7, Ser II, " Report on Exploratory Voyages to Lousy Bank and Adjacent Areas," by Lieut Pawsey, G T Atkinson, and H H Goodchild, describes some very careful work done in the investigation of a new fishing-bank north from Rockall (H M S O, 1924, 3*s* net) No 6, vol 7, Ser II, " Report on the English Plaice Investigations in the North Sea during the Years 1921–1923 " by J O Borley and Miss D E Thursby-Pelham (H M S O, 1925, 13*s* net), is a very clearly written and readable account of the investigations that have been made since the War on the apparent increase in the plaice stock of the North Sea as a result of the great decrease in fishing during the period of military operations and restrictions The results of the international inquiries and the recommendations that were made are also given It contains a very good bibliography and is a very important work

Some notable publications of the International Council for the Exploration of the Sea have also appeared recently Dr Martin Knudsen has prepared a *Bulletin Hydrographique* (1924), dealing in a general way with the observations made during the years 1920–1–2–3 Dr Ed le Danois has edited the *Rapport Atlantique* (*Rapports et Proces-Verbaux*, vol 35, January, 1925) This contains the results of the investigations made by the " Atlantic Slope Committee,' and it includes a very interesting discussion of the transgressions of Atlantic oceanic water into the shallow European seas There is a discussion of the relation of this oscillatory movement of superficial Atlantic water to the long periodic tides *Publication de Circonstance* No 84 (1924), is a description, in English, by Messrs Ostenfeld and Jespersen, of the " standard plankton net " which was to have been designed by the late E W Nelson The instrument is a modified " Nansen net," hauled in the way devised by Mr H J Buchanan Wollaston of the English Fishery Investigations Staff

University and Educational Intelligence

AN Aitchison Memorial Scholarship, of the value of 36*l* and tenable for two years in the full-time day course in technical optics, at the Northampton Polytechnic Institute (London), is being offered to students of both sexes The examination will be held on September 22 and 23 Particulars can be obtained from the Hon Secretary and Treasurer, Mr Henry Purser, 42 Grays Inn Road, London, W C 1

THE Air Ministry announces that the next examination of candidates for entry as flight cadets to the Royal Air Force Cadet College, Cranwell will begin on November 17, when 35 cadetships will be offered Forms of entry, which can be obtained from the Secretary, Civil Service Commission, Burlington Gardens, W 1, will not be accepted later than September 17 Candidates must be medically fit and be between the ages of 17½ and 19½ years Cadets undergo a two years course at the College, where, in addition to continuing their general education, they receive a thorough training in all questions concerning military aviation and cognate subjects, and also graduate as service pilots Full details as to entry into Cranwell are contained in Air Publication 121, Regulations for admission to the Royal Air Force Cadet College (H M Stationery Office, Kingsway, W C 2, 6*d* net)

THE universities receive each year from the grant-aided schools in England and Wales 4½ per cent of the total number of pupils leaving the schools The president of the Board of Education recently directed attention to this percentage as being abnormally small In the United States, according to an article in the April issue of *School Life* 350,000 boys and girls—six times as many as a quarter of a century ago—will be completing their public high-school course this year, and of this number 112,000 will go to college and 50,000 will enter other institutions to continue their education This abundant supply of recruits for post-secondary education affords evidence of widespread prosperity, but their acceptance is not an unmixed advantage either to them or to the institutions receiving them The president of the Carnegie Foundation for the Advancement of Teaching says in his annual report for 1923–24 that the colleges and professional schools admit each year a growing army of high-school graduates who lack the qualities of intellectual training which would fit them for fruitful college study, for they have not learned to use their minds This is in some measure due to the gradual substitution of a new ideal of the meaning of a liberal education for the old-time conception of training the habits and powers of the mind The mere acquisition of knowledge, formerly regarded as a secondary matter, has become the main thing "Our high schools and colleges seek to give their pupils something from every field of thought Following the advice of Herbert Spencer they labour to present these packages of knowledge in the most agreeable forms The text-books offer every variety of predigested knowledge It is exactly the reverse of that intellectual training which the study of science ought to bring' One of the most pressing needs of the time, moreover is to diminish the subserviency of the school to the college and to open up from the elementary and from the secondary schools leadings to technical schools in the trades, in agriculture, and in the arts The vocational courses given in the high school are no substitute for "the sharp, precise training that makes for the sort of technical skill that adds joy to work and is one of the most prolific sources of human happiness"

Early Science at Oxford

August 12, 1684 (*continued*) Dr Alexander Pudsey, Fellow of Magdalen College, subscribed to ye Articles and then sate as President

Dr Plot communicated some of ye bark of ye clove tree, it had a strong aromatick tast, very much like cloves, and very differing from Cinnamon, which has sometimes been thought to be ye bark of this tree He communicated also some patterns of ffirr, taken up in ye old *dewet pool*, in ye parish of Norbury in Staffordshire so full of Turpentine, that it is transparent, this is that which they use as candles and may well be thought to have adventitious Bitumen from ye moores, wherein it lies, for forreign firr is not so transparent, will not burn so well and that this is firr, appears very probable, because some of ye trees taken up have six branches at ye annuall distances, which, as ye Doctor thinkes, no trees, but firrs, have

August 19, 1684 The Society being met, ye following experiments were tried, by Mr Musgrave

Human spittle, clarified by standing, being mix't with syrup of violets, turned to a delicate *green* color Part of a Mucous substance, taken out of ye Stomach of a Jack near ye Pylorus, and mixt with solution of sublimate, became much whiter, than it was before Another part of it, mix't with syrup of violets, turned *green*

The same person has observ'd like effects, by mixing a liquor found in ye stomach of a *Hedghog*, with syrup of violets, and with solution of sublimate

These Experiments are urged as an argument against ye existence of an *acid ferment* in ye stomach It seems probable, that ye great worke of Digestion proceeds from a *volatile alcali*

He also tooke notice of a large *bed of Glands*, makeing about ye ⅗ths of ye inside of ye stomach, and seated near ye pylorus, of a Jack, the whole bed appears of a brownish red color, and is divided into severall Ridges, which run parallel to one another, and ye same way with ye stomach, for ye better contraction of that part especially when empty, (at which time these Glands being fix'd to the inmost coat, are, together with it, drawn up into wrinkles), that edge of this bed of glands, which is nearest ye head of ye fish, is dented, ye ridges breaking off on a sudden but at ye other end, on this side ye Pylorus, they diminish almost insensibly

By these Glands, he supposes, at least a considerable share of ye menstruum (the great efficacy of which makes this fish a fit subject to illustrate ye nature of Digestion) is seperated from ye blood, for blood vessels may be seen in great numbers on ye other side of ye glands, and inner tunic, by seperating it, and them, from the middle and musculose tunic, and, as a farther argument of this use of ye glands, he has observed, that that part of ye stomach where they are is generally moister, then the other part near ye mouth, and that in dissecting Jacks, whose stomachs have been filld with some large fish of ye pinnaceous kind, (which must enter with ye head foremost) ye head, and foremost parts, of ye devoured fish, have, as far as the glands reach, been either actually dissolv'd, or fairly turning, into a mucilage, whereas, at ye same time ye other, and less bony, part of ye included fish, being not yet come within ye power of the menstruum, has still retain'd its form, and consistence

Mr Walker presented ye Society with ye draughts and descriptions, of two sorts of Wooden Bridges, contrived without any pillar under them, tho of a considerable length these accounts will be printed very suddenly

Societies and Academies

LONDON

Faraday Society, July 6 —A L **Marshall** The electrodeposition of zinc from sulphate solutions With pure solutions, the efficiency of zinc deposition always increases with rising temperature , an explanation based on chemical polarisation is given A convenient copper coulometer has been developed for measuring currents up to 15 amperes or more —J B **O'Sullivan** The application of the quinhydrone electrode to the measurement of P_H valves in solutions containing copper ions and other divalent ions The quinhydrone electrode can be employed in many cases in which the ordinary hydrogen electrode cannot be used on account of its greater reducing power This applies not merely to salts of copper, which are electro-positive towards hydrogen, but also to neutral or weakly acid solutions of the salts of such metals as tin, lead and nickel The quinhydrone electrode is itself limited in its applicability by its reducing power Thus it cannot be employed even in moderately acid solutions of the salts of mercury, silver or gold, which have normal electrode potentials of more than 0 7 volt —F M **Cray** and G M **Westrip** The preparation of solutions of standard hydrogen ion concentration and the measurement of indicator ranges in an acetone-water mixture Solutions of standard hydrogen ion concentration ranging from P_H 12 5-2 0 have been prepared and calibrated by means of the quinhydrone electrode in a solvent containing 10 volumes of water in 100 of acetone-water These solutions have been used in the measurement of the P_H ranges of a large number of indicators in the specified solvent Their behaviour in these standard solutions is consistent with their P_H values, as determined by the quinhydrone electrode, within 0 1 P_H

DUBLIN

Royal Irish Academy, June 22 —A K **Macbeth** and J **Craik** Condensation reactions of indoxyl and 3-oxy(1)thionaphthen In the course of some work, a trustworthy method of estimating 3-oxy(1)thionaphthen was found necessary, and its condensation reactions with several aldehydes were therefore examined in some detail Typical condensation products were formed by the interaction of the thioindoxyl and anthraquinone-2-aldehyde, 5-nitroanthraquinone-2-aldehyde, 1-chloroanthraquinone-2-aldehyde, and isatin The condensations take place quantitatively and the thioindogenides produced are characterised by their high melting points and marked insolubility in organic solvents The reactions are therefore of value in estimating 3-oxy(1)thionaphthen The indogenides obtained by the condensation of indoxyl with anthraquinone aldehydes were prepared for comparison with the series of thioindogenides the latter were all found to be yellow-coloured compounds in contrast with the deep-red or brown products obtained in the former case

EDINBURGH

Royal Society, June 22 —W H **Lang** Contributions to the flora of the Old Red Sandstone of Scotland (*a*) On plant-remains from the fish-beds of Cromarty (*b*) On a sporangium-bearing branch-system from the Stromness beds Plant-remains from the grey clay or micaceous sandstones of the Cromarty fish-beds include more than eight distinct types of spores and two types of sporangia found free n the rock Some features of the vegetative organs of *Thursophyton Milleri* are described but nothing is yet known of the reproductive organs of this plant The smooth, branched axes are referred to *Hostimella* sp and some of them have axillary structures like those recorded for *Hostimella hostimensis* from Bohemia Two types of plants with attached sporangia containing spores are named provisionally *Hostimella globosa* and *H pinnata* Large oval sporangia borne on a raceme-like branch-system, from the Stromness beds of the same age are named *H racemosa* —F A E **Crew** Rejuvenation of the aged fowl through thyroid medication Cock-feathered cocks become hen-feathered the plumage of hen-feathered cocks and of hens is unaffected save that there is an increased melanism The egg-yield is increased and old birds are rejuvenated —A Crichton **Mitchell** On the changes in vertical force during the "sudden commencement" of a magnetic storm The "sudden commencement" of the slight magnetic storm of Sept 4, 1924, was observed at Eskdalemuir Observatory by means of a large coil laid horizontally on the ground the current induced in the coil by the sudden change in vertical force being recorded photographically by a galvanometer in the circuit

ADELAIDE

Royal Society of South Australia, May 14 —L Keith **Ward** Notes on the geological structure of Central Australia The salient features of both the fundamental complex forming the core of the MacDonnell Ranges and of the sediments deposited upon these foundations in the central portion of Australia are described The palæontological and stratigraphical data when correlated are regarded as proof of the exclusion of the supposed Cambrian system from the central area and the existence of an immensely thick series of Ordovician sandstones and limestones These are overlain, in the southern part of the Northern Territory, by beds comprising glacial tillites—presumably of Permo-Carboniferous age Then follow successively Jurassic sands, Lower and Middle Cretaceous shales, and recent deposits of fluviatile and æolian origin A dense crust of chalcedonic silica caps alike the Ordovician, Permo-Carboniferous, and Cretaceous rocks Glacial action in Upper Cretaceous time was widespread through the northern part of South Australia The correlation of the formations described with those of adjoining regions is discussed and the evolution of the structure outlined The great central depression of Australia exerted an important influence on the development of the drainage system

CAPE TOWN

Royal Society of South Africa, May 20 —S H **Haughton** Tracks of animals preserved in the Ecca Shales of the Cape Province The specimens are from two localities in the Ecca Beds one in the Zak River area Calvinia, and the other from the cutting (Ecca Pass) on the road from Grahamstown to Fort Beaufort, localities separated by a distance of 350 miles The tracks include numerous crustacean foot-prints and the trails of worms The vertebrate tracks consist in part of small groups of four-toed so-called "amphibian" prints which lack a heel-pad in part, doubtfully, of oval impressions with a finely corrugated surface, as if due to the impress of a skin-covered "hoof-like" foot, and in part of a series of peculiar parallel sinuous lines possibly made by ventral spines of a fish armed after the fashion of the Carboniferous and Permian Acanthodes —J H **Power** Notes on the habits and life-histories

of certain little-known Anura with descriptions of the tadpoles *Cassina Senegalensis*, *Phrynomantis bifasciata*, and *Bufo carens*, collected by Lobatsi, are described The tadpole of Cassina was observed to devour mosquito eggs —F von **Huene** Some additions to the knowledge of Procolophon, Lystrosaurus, Noteosuchus, and Cistecephalus An impression of the skin surrounding the parietal foramen of a specimen of Procolophon shows small polygonal pits bounded by thick meandering walls The large parietal foramen possibly contained a functional organ The skull of Lystrosaurus contains a transverse bone (ectopterygoid) in the same position as in Dicynodon —K H **Barnard** Report on a collection of Crustacea from Portuguese East Africa The present collection contains 57 species of which 14 have been previously recorded The capture of a crayfish of the genus Palinustus, hitherto known only from the West Indies, and of three Indo-Pacific forms not reported since their discovery by the *Challenger*, are the most striking results Two new varieties and two new species are described —J **Groves** and Edith L **Stephens** New and noteworthy S A Charophyta South Africa is rich in endemic types belonging to the group some of them of outstanding beauty and interest, and this paper describes six of these new species —W J **Hodgetts** Contributions to our knowledge of the freshwater algæ of Africa No 6 Some freshwater algæ from Stellenbosch 184 species are recorded, and nine species, eight varieties, and several forms are described as new The most striking feature of the collection is the relatively large number (53) of species of desmids, a group rather scantily represented in collections from other parts of South Africa —F G **Cawston** Some observations of the radulæ of freshwater Mollusca The cones and cusp-formation of the radulæ of freshwater mollusca which serve as intermediate hosts for Trematoda in South Africa are described

ROME

Royal Academy of the Lincei, May 2 —Guido **Fubini** Varieties with collinear plane sections —Gino **Fani** The surfaces of space S_3 with collinear plane sections —S **Pincherle** Certain functional transformations —Leonida **Tonelli** Green's theorem —M La **Rosa** Experimental foundations of the ballistic principle applied to the velocity of light —M **Cisotti** Dynamic effect of a current flowing between a cylinder and an undefined plane wall —O M **Corbino** and E **Persico** Influence of a magnetic field on the action of a three-electrode lamp —Luigi **Fantappie** Linear analytic functionals and their singularity —Luigi **Fantappie** The derivation of analytic functionals —S **Finikoff** The principal surfaces of Bianchi's rectilinear congruences —Letterio **Laboccetta** Analytic representation in finite form of the functions the diagrams of which consist of a succession of arcs of different lines varying according to a definite law from one interval to the next —D J **Struik** Rigorous determination of the periodic irrotational waves in a channel —R **Serini** Capacity of the electric condenser with infinitely thin circular plates —F De **Carli** The capacity for reaction in the solid state of anhydrides and metallic oxides The reactivity of anhydrides with metallic oxides in the solid condition is general and varies with the nature of the reacting oxides, being most marked with oxides of the alkaline earth metals and also with boric, molybdic, tungstic, vanadic, and silicic anhydrides —Emilio **Oddone** Alterations caused in isobaric configurations by calming of the air —G **Brunelli** Autotomy of the posterior lobe of the vitellin sac in *Salmo salar* L —Silvio **Ranzi** An organ of sense derived from the first epibranchial placoid of Selachi —Filippo **Eredia** Forecast of the almond crop of any season on the basis of the air temperature and rainfall in the three months January to March inclusive —Primo **Dorello** The functions of the peduncle diverticulum, and Swammerdam's vesicula in the genus Helix

May 17 —Guido **Fubini** An observation of the transcendent d (z) of Pincherle —Francesco **Severi** Theory of the correspondence between algebraic curves —U **Cisotti** Dynamic effect of a current circulating round a cylinder in a tunnel —Fil **Bottazzi** and L De **Caro** Variations produced in the electrical resistance of the muscles by various physical and chemical agents The results are given of investigations on the influence of temperature on the electrical resistance of muscle and essentially connective membranes, and on the isoelectric point of muscular colloids —Seb **Timpanaro** Experiments on floating laminæ —G **Scagliarini** Additive compounds of stannic iodide and organic bases —P **Comucci** Azurite from Pistello (Elba) —G **Brunelli** Significance of the oily drops in the egg of Teleostei and location of the oxidases —G **Amantea** Investigations on the spermatic secretion xvi Collection of the sperm and elimination of the spermatozoa of the pigeon —Umberto **D'Ancona** Double innervation of the muscles of the decapod crustaceans —V De **Laurenzi** Parotid secretion in man caused by various peripheral factors —Nazzareno **Grisogani** Rhythm of the parotid secretion in man and gustatory and olfactory sensations —Cesare **Artom** Abnormal segmentation at the commencement of development in the egg of Cagliari s *Artemia salina diploide*

SYDNEY

Linnean Society of New South Wales, April 29 —G H **Hardy** Australian Mydaidæ (Diptera) A descriptive and synonymic catalogue of the dipterous family Mydaidæ, containing two genera and nine described species recognised as valid —J R **Malloch** Notes on Australian Diptera No v Keys are presented for the recognition of the genera of Muscidæ known from Australia, together with a key for the species of Helina, of which four are described as new —F G **Clapp** A few observations on the geology and geography of North-west and Desert Basins, Western Australia —A H K **Petrie** An ecological study of the flora of Mount Wilson, Part II The Eucalyptus forests The Eucalyptus forests form the main plant-covering of the sandstone plateau, and also occur on the outskirts of the basalt residuals Discussing the ecology of Eucalyptus forests special reference is made to their relation to fires Further observations are also recorded on the stratum-societies of the junction flora, with a special discussion of the status of the Pteridium society

Royal Society of New South Wales, May 6 —C **Anderson** The Australian fauna (Presidential address) The fauna has often been described as the most interesting and important in the world Australia became separated from other continental masses in late Cretaceous or very early Tertiary times, and, protected by their isolation from the competition of later and higher forms, the animals of Australia are in many instances archaic survivals, which are closely related to forms long since extinct

in other lands The dispute as to the route whereby the marsupials and other forms entered Australia will probably be settled only by further discoveries, particularly in palæontology

VIENNA

Academy of Sciences, May 7 —Ph **Furtwangler** On minimal bases for bodies of rational functions —F **Hemmelmayr** and T **Meyer** The influence of various substitutes on the tenacity of the carboxyl group in substituted aromatic acids, the influence of a second carboxyl group and the relative activity of chlorine and bromine —C **Diener** Geological investigations on the Millibrunnkogel near Aussee in Styria —A **Blumenstock** On the preparation of stearolacton —J **Lindner** and A **Siegel** The course of the chinaldin synthesis in the tetralyl-amines, 7, 8-tetra-methylen-chinaldin —J **Lindner** and M **Staufer** The course of chinaldin synthesis in β-amino-tetralin —G **Weissenberger**, F **Schuster**, and H **Pamer** On organic molecular compounds (xiii) Studies on the calculation of vapour pressure curves —K **Mayrhofer** Representation of a complex of rays by a dual quadratic differential form

WASHINGTON, D C

National Academy of Sciences (Proc, Vol 11, No 5, May) —W C **Boeck** and J **Drbohlav** The cultivation of *Endamœba histolytica* An organism from human fæces, which agrees with *E histolytica* in movements, nutrition, morphology, and pathogenicity, has been cultivated on Locke egg-serum and Locke egg-albumin *E histolytica* in culture feeds on bacteria and blood corpuscles, if they are present The cultured organisms were as pathogenic to kittens as fresh material —S F **Chiang** The rat as a possible carrier of the dysentery amœba Rats can be infected with *E histolytica* of human origin by feeding material containing cysts Infection is transmitted readily from rat to rat by association in the same cage, and may persist for four months Apparent varieties of *E histolytica* occur spontaneously in laboratory rats The rat may therefore be a possible carrier of the causal organism of amœbic dysentery —L P **Eisenhart** Linear connexions of a space which are determined by simply transitive continuous groups —J W **Alexander** Note on a theorem by H Kneser —L **Ingold** Associated types of linear connexion —J M **Thomas** Conformal correspondence of Riemann spaces —C **Barus** Pinhole probe measurements of the phase change of the telephonic end plates, acting on a closed cylindrical air column in longitudinal acoustic vibration —E B **Wilson** On the Boltzmann equation $\rho=\rho_0 \exp(-w/kt)$ —H **Kahler** The band spectra of crystals and complex gases —E B **Wilson** and W J **Luyten** The frequency distribution of some measured parallaxes and of the parallaxes themselves 313 determinations of parallaxes of stars between magnitudes 5 and 6 were used On probability paper, the distribution gives a straight line within the errors of sampling Graphs are given of the frequency distribution on a parallax base —E W **Brown** The effect of varying mass on a binary system If rate of change of momentum equals force, angular momentum remains constant while a real velocity increases and, unless the two masses are equal, the velocity of the centre of mass increases The hypothesis thus provides for increase of velocity of the star with age (Russell s scheme of evolution) and the velocity of a single star relative to the centre of mass of the whole stellar system will decrease

Official Publications Received

Joint Board of Research for Mental Diseases City and University of Birmingham Annual Report of the Laboratory for Year ending March 1925 Pp 11 (Birmingham)

Papers from the Geological Department, Glasgow University Vol 7, 1924 Pp iv+302 (Glasgow Jackson, Wylie and Co)

Proceedings of the American Academy of Arts and Sciences Vol 60, No 1 The Geology of Ascension Island By Reginald A Daly Pp 80+21 plates (Boston, Mass) 3 dollars

University College of South Wales and Monmouthshire Faculty of Science Information regarding Courses and Careers open to Students of Science Pp 22 (Cardiff)

His Majesty s Stationery Office, 1786-1925 Brief Guide to Government Publications Pp 34 (London H M Stationery Office) 3*d* net

Publikace Pražské Státní Hvězdárny (Publications de l Observatoire National de Prague) No 1 Troisième étude sur l appareil circum zenithal 1ere partie Sur le principe et sur les développements possibles de l appareil Par Fr Nušl Pp 20 No 2 Troisième étude sur l appareil circumzenithal 2eme partie Construction de l appareil modèle transportable 1922 Par Josef Jan Fuč Pp 19 No 3 Comparaison mondiale des pendules, fractionnaire Par Fr Nušl Pp 10 (Prague)

Publications of the Kapteyn Astronomical Laboratory at Groningen No 36 The Number of Stars between definite limits of Proper Motion Visual Magnitude and Galactic Latitude for each Spectral Class By Prof Dr P J van Rhijn Pp 16 No 37 Comparison between Trigonometric, Spectroscopic and Mean Statistical Parallaxes By Prof Dr P J van Rhijn Pp iii+31 No 39 The Proper Motions of 656 Stars derived from Plates taken at the Helsingfors Observatory measured and discussed by W J Klein Wassink Pp 25 (Groningen Hoitsema Bros)

Government of Madras Local Self Government Department (Public Health) Chemical Examiner, Madras, Annual Report, 1924 Pp 14 (Madras)

Norman Lockyer Observatory Director s Annual Report, April 1, 1924–March 31 1925 Pp 8 (Sidmouth)

The Norman Lockyer Observatory Salcombe Hill Sidmouth Council s Report and Accounts, and List of Council, Staff, Members, etc, June 1925 (as adopted at Annual General Meeting, June 11th 1925) Pp 8 (Sidmouth)

Catalogue of Indian Insects By T Bainbridge Fletcher Part 7 Lasiocampidæ Pp 29 10 annas 1s Part 8 Amatidæ (Syntomidæ) Pp 35 (Calcutta Government of India Central Publication Branch)

Transactions of the South Indian Branch of the British Medical Association Vol 17, No 3 Pp 105 161 (Madras)

Department of the Interior Bureau of Education Bulletin, 1925, No 6 High School Education of the Farm Population in selected States By E E Windes Pp 24 (Washington Government Printing Office) 5 cents

The Rockefeller Foundation a Review for 1924 By George E Vincent Pp 48 (New York City)

Transactions of the Royal Society of Edinburgh Vol 53, Part 3, No 32 The Continuity of the Vertebrate Nervous System Studies on Lepidosiren Paradoxa By Frances M Ballantyne Pp 663 670+6 plates (Edinburgh R Grant and Son London Williams and Norgate, Ltd) 3s

The Rowett Research Institute Collected Papers Vol 1 Edited by Dr John Boyd Orr Pp 575 (Aberdeen Reid Library of the Rowett Research Institute) 21s

Uganda Protectorate Annual Report of the Geological Survey Department for the Year ended 31st December 1924 Pp 13 (Entebbe)

Denkschriften der Schweizerischen Naturforschenden Gesellschaft Mémoires de la Société Helvétique des Sciences Naturelles Band 59 (Vol 59) Beiträge zur Kenntnis der Skelettbildung bei domestizierten Säugetieren auf Grund röntgenologischer Untersuchungen Anlage und Entwicklung des Knochenskelettes der Vorder und Hinterextremität des Hausrindes (Bos taurus L) Von Max Kupfer und Hans R Schinz Pp viii+133+28 Tafeln Band 60 Abh 1 (Vol 60, Mém 1) Die Hemipterenfauna des Schweizerischen Nationalparkes (Heteropteren und Cicadinen) Von Dr B Hofmänner Pp xii+174+2 Tafeln Band 61, Abh 1 (Vol 61 Mem 1) Die Magdalénien Station bei Ettingen (Basel land) Von Fritz Sarasin und H G Stehlin Mit einem Nachtrag zur Faunula der Magdalenien Station am Schlossfelsen von Thierstein, von H G Stehlin Pp vi+137+16 Tafeln (Zurich Gebruder Fretz A G)

The Journal of the Ipswich and District Natural History Society Vol 1, Part 1, June Edited by Henry Ogle Pp viii+68 (Ipswich)

The Institution of Gas Engineers Eleventh Report of the Gas Investigation Committee Aeration and Air Injection Part 2 Pp 63 108 Twelfth Report of the Gas Investigation Committee Waste Heat Boilers Pp 109 168 Institution Gas Research Fellowship, 1924 The Gasification of Coke in Steam, with Special Reference to Rates of Gasification and the Composition of the Gas By Dr S Pexton and Prof J W Cobb Pp 292 325 (London)

University of California Publications in Zoology Vol 27 A Synopsis of the Amphibia of California By Tracy I Storer Pp v+342+18 plates (Berkeley Calif) 4 50 dollars

Bulletin of the Experimental Station of the Hawaiian Sugar Planters Association Entomological Series Bulletin No 17 The Field Rat in Hawaii and its Control By C E Pemberton Pp v+46 (Honolulu)

Rainfall in Chosen (Korea) Compiled by the Meteorological Observatory of the Government General of Chosen Pp 186+27 maps (Zinsen, Chemulpo)

Koninklijk Magnetisch en Meteorologisch Observatorium te Batavia Verhandelingen No 8 Het Klimaat van Nederlandsch Indie (The Climate of the Netherlands Indies) Door Dr C Braak Deel 1 (Vol 1), Algemeene Hoofdstukken (General Chapters), Aflevering 8 (Part 8) With English Summaries Pp iii+499 528+249 272 Verhandelingen No 13 Isomagnetics for the Netherlands East Indian Archipelago, Epoch 1925 0 By Dr S W Visser Pp ii+18+4 plates Verhandelingen No 16 Some Researches into the Propagation of Seismic Long Waves By Dr S W Visser Pp ii+24 (Batavia)

NATURE

SATURDAY, AUGUST 15, 1925

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Oil in Navigable Waters

IN a recent publication ("Oil in Navigable Waters," H M S O, 1925, *6d*) the Board of Trade has made a valuable contribution to the problem of abating the pollution of the sea by oil The inquiries made by the engineering staff show that those ships which carry fuel oil in bulk and use their oil tanks for water ballast are the most likely to cause pollution at present, and in the near future In these cases a large bulk of water is mixed with oil, and is separable from the oil only with difficulty and uneconomically It is considered that separators can now be designed to deal with any ordinary mixture of oil and water so efficiently that the water discharged from this mixture into the sea is sufficiently free from oil to be innocuous, and the provisions of the Oil in Navigable Waters Act of 1922 are ensuring that oil-free water from such mixtures is being pumped into the sea at least within the three-mile limit Nevertheless, if the shores of Britain are to be kept free from oil, it will be necessary to extend the limit to a much greater distance than three miles to restrict the pollution to that oil, which, Lord Bearsted has pointed out in the *Times*, may be escaping from vessels sunk during the War

It is known (see Orton, NATURE, vol 90, 1913, p 700) that continuous strong south-westerly winds will blow the Portuguese Man-of-War (Physalia) and Velella from the sub tropical Atlantic regions up the Channel on to the southern shores of England, over a distance which must be reckoned at least in several half-hundreds of miles, hence there can be no doubt that continuous strong inshore winds may blow oil from deep water on to the shores, notwithstanding tidal currents It is also apparent that oil discharged in an estuary outside the three-mile limit, but on an incoming tide, may easily result in an accumulation of oil on the shore

With regard to this aspect of the problem, Mr A W Bibby has recently pointed out that British merchant ships would be at a still greater disadvantage in comparison with foreign ships, if the limit were extended and applicable only to British ships, and that, therefore, we must look to an international agreement to extend the distance within which oil may not be discharged at sea, say, to ten miles off-shore, to give greater protection to the shore There are signs that the sensitiveness of nations with regard to any alteration of the territorial three-mile limit is breaking down in the recent Anglo-American agreement to permit examination of British vessels inside a ten-mile limit from the American coast The influential body comprising the American National Coast Anti-Pollution League —which has passed a resolution "that the dumping of oil waste and refuse is ruining the bathing beaches

situated on the territorial waters of the various countries, that the pollution takes place on high seas as well as territorial waters, that the President of the United States was authorised and requested to call a Conference of Maritime Nations with a view to adopting effective means for the prevention of the pollution of navigable waters "—is also apparently ready to approve an agreement giving greater protection to all shores

The inquiries made by the Board of Trade brought from local and harbour authorities, coastguards, sea fisheries committees, and district inspectors of fisheries, numerous observations on the deplorable destruction of sea-birds from contact with oil, cases of damage to paintwork of boats, piers, and other permanent structures, risk of fire in enclosed waters, and a variety of opinion on the effect of oil on "fish" life With regard to opinions on the effect of oil on marine organisms, they are mainly uncritical, but the statement by the North-eastern Sea Fisheries Committee that "crabs, lobsters, shrimps, and prawns are quickly smothered and killed by oil," is worth substantiation, as is also that made by more than one body that oil causes fishing-nets to rot very quickly There is a general agreement in the replies that pollution has decreased markedly in most areas since the introduction of the Oil in Navigable Waters Act, 1922

Among the general public there is, fortunately, much interest in problems connected with the loss of oil at sea, and many valuable observations have been made in the Press Lord Rayleigh has calculated that half-a-million tons of oil could cover the whole ocean with a film, but has not postulated the conditions in which it would do so Prof H E Armstrong has stated that a film of oil would not deprive marine life of oxygen or light, but might react on that life in an insidious but undefined manner It has been pointed out that oil bubbles into the Caspian Sea in a perpetual stream, but that although fishing is poor in the locality of the escaping oil, there is heavy fishing in neighbouring parts of that sea, and other writers have observed that oil which has risen to the surface of water in oil-bearing regions, has after a short time sunk again after the evaporation of the lighter constituents The latter observations are hopeful in considering the fate of floating masses of oil, and are well worth further investigation

The sum of the information now available on these problems is useful, but might be made still more valuable if followed up by an enumeration and chemical examination of (1) the different kinds of fuel oils, and (2) the waste oils actually discharged from the bilges or tanks of oil-burning vessels A certain amount of data on these matters exists, but a departmental investigation would collect and place on record together just that kind of information we at present lack

Primitive Law

Primitive Law By E Sidney Hartland Pp vi+222 (London Methuen and Co, Ltd, 1924) 7s 6d net

ANTHROPOLOGY is to most laymen and to many specialists still mainly an object of antiquarian interest There are, however, certain aspects of it which are of a genuine scientific character, in that they do not lead us beyond empirical fact into realms of uncontrollable conjecture, in that they widen our knowledge of human nature, and in that they are of a direct practical application I mean such a subject, for example, as primitive economics, important for our knowledge of man's economic dispositions and of value to those who wish to develop the resources of tropical countries, employ indigenous labour and trade with the natives Or again a subject such as the comparative study of the mental processes of savages, a line of research which has already proved fertile to psychology and might be made useful to those engaged in educating or morally improving the native Last, but not least, there is the subject of primitive law, the study of the various forces which make for order uniformity and cohesion in a savage tribe The knowledge of these forces should have formed the foundation of anthropological theories of primitive organisation and it should have yielded the guiding principles of Colonial legislation and administration Yet of all branches of anthropology, primitive jurisprudence has received in recent times the scantiest and the least satisfactory treatment This is the reason why the present book by Mr Sidney Hartland deserves special attention, devoted as it is exclusively to the discussion of primitive law and written by one who is both a learned anthropologist and a professional lawyer

Anthropology has not always been so indifferent about savage justice and the methods of its administration as it is at present About half a century ago there was a positive epidemic of research into primitive law, especially on the Continent, more particularly in Germany It is enough to mention the names of Bachofen, Post, Bernhoft, Kohler and the other writers grouped round the *Zeitschrift fur vergleichende Rechtswissenschaft*, to remind the sociologist of the scope, volume and quality of the work done by them This work, however, was heavily handicapped The writers had to rely upon the data of the early amateur ethnographers—modern field-work of the trained specialist, done with method, purpose and knowledge of the problems, was at that time not yet in existence In an abstract and complex subject, such as primitive law, amateur observations are, on the whole, useless

The early German students of savage law again were all and one committed to the hypotheses of "primitive

promiscuity" and "group-marriage," just as their British contemporary, Sir Henry Maine, was handicapped by his too narrow adhesion to the patriarchal scheme. Most of these continental efforts in anthropological jurisprudence were directed to—in fact, wasted upon—the task of proving that Morgan's theories are correct. The myth of "group-marriage" was casting its shadow on all their arguments and descriptions and it infected their juridical constructions with the kindred concepts of "group-responsibility," "group-justice," "group-property," and "communism," in short, with the dogma of the absence of individual rights and liabilities among savages.

Underlying all these ideas was the assumption that in primitive societies the individual is completely dominated by the group—the horde, the clan or the tribe—that he obeys the commands of his community, its traditions, its public opinion, its decrees, with a slavish, fascinated, passive obedience. This assumption, which gives the leading tone to most modern discussions upon the mentality and sociality of savages, in the French school of Durkheim, in most American and German works and in some English writings, has survived, as we shall see, right into the present work of Mr. Sidney Hartland.

Thus handicapped by insufficient material and baseless assumptions, the early school of anthropological jurisprudence was driven into an impasse of artificial and sterile constructions. In consequence it proved incapable of real vitality, and the whole interest and work heavily slumped—in fact, almost entirely subsided—after its first short-lived boom. One or two important books on the subject appeared—Steinmetz's inquiries into the beginnings of punishment, Durkheim's analysis of early criminal and civil law—but on the whole, the first impetus has proved so little inspiring that most modern anthropologists, both in theory and in field-work, ignore its very existence. In the standard manual "Notes and Queries on Anthropology," "law" appears neither in the index nor in the table of contents, and the few lines devoted to it under the heading of "Government. Politics," excellent as they are, do not correspond in any way to the importance of the subject. In the book of the late Dr. Rivers on "Social Organisation" the problem of primitive law is discussed only incidentally, and, as we shall see, it is rather banished from primitive sociology than included in it by the author's brief reference to it.

This lacuna in modern anthropology is due, not to any oversight of primitive legality, but on the contrary to its over-emphasis. Paradoxical as it sounds, it is yet true that present-day anthropology neglects primitive law just because it has an exaggerated, and I will add at once a mistaken, idea of its perfection. Thus we read in the present book the following sentences: "The savage is far from being the free and unfettered creature of Rousseau's imagination. On the contrary, he is hemmed in on every side by the customs of his people, he is bound in the chains of immemorial tradition not merely in his social relations, but in his religion, his medicine, in his industry, his art: in short, every aspect of his life" (p. 138). With all this we might agree, except that it seems doubtful whether the "chains of tradition" are identical or even similar in art and in social relations, in industry and in religion. But when, immediately, we are told that "these fetters are accepted by him (the savage) as a matter of course; he never seeks to break forth"—we must enter a protest. Is it not contrary to human nature to accept any constraint as a matter of course, and does man, whether civilised or savage, ever carry out unpleasant, burdensome, cruel regulations and taboos without being compelled to? And compelled by some force or motive which he cannot resist?

Yet this automatic acquiescence, this instinctive submission of every member of the tribe to its laws, is the fundamental axiom laid at the basis of the inquiry into primitive order and adherence to rule. Thus another foremost authority on the subject, the late Dr. Rivers, speaks in the book already mentioned of an "unwitting or intuitive method of regulating social life," which is, according to him, "closely connected with primitive communism." And he proceeds to tell us: "Among such peoples as the Melanesians there is a group sentiment which makes unnecessary any definite social machinery for the exertion of authority, in just the same manner as it makes possible the harmonious working of a communal ownership and insures the peaceful character of a communistic system of sexual relation" ("Social Organisation," p. 169).

Thus here again we are assured that "unwitting" or "intuitive methods," "instinctive submission" and some mysterious "group-sentiment" account for law, order, communism and sexual promiscuity alike! This sounds altogether like a Bolshevik paradise, but is certainly not correct in reference to Melanesian societies, which I know at first hand.

A similar idea is expressed by a third writer, who has contributed towards our understanding of the organisation of savages from the point of view of mental and social evolution more perhaps than any one living anthropologist. Prof. Hobhouse, speaking of the tribes on a very low level of culture, affirms that "such societies, of course, have their customs, which are doubtless felt as binding by their members, but if we mean by law a body of rules enforced by an authority independent of personal ties of kinship and friendship, such an institution is not compatible with their social

organisation" ("Morals in Evolution," 1915, p. 73). Here we have to question the phrase "felt as binding" and ask whether it does not cover and hide the real problem instead of solving it. Is there with regard to some rules at least, no binding mechanism, not perhaps enforced by any central authority, but backed up by real motives, interests and complex sentiments? Can severe prohibitions, onerous duties, very burdensome and galling liabilities, be made binding by a mere "feeling"? We should like to know more about this invaluable mental attitude at least, but the author simply takes it for granted. Again, the minimum definition of law as the "body of rules, enforced by an authority independent of personal ties," seems to me to be too narrow and not to lay the emphasis on the relevant elements. There are among the many norms of conduct in savage societies certain rules regarded as compulsory obligations of one individual or group towards another individual or group. The fulfilment of such obligations is usually rewarded according to the measure of its perfection, while non-compliance is visited upon the remiss agent. Starting with such a comprehensive view of law and inquiring into the nature of the forces which make it obligatory, it is possible to arrive at much more satisfactory results than taking the question of authority, government and punishment for starting points.

To take another representative opinion of one of the highest anthropological authorities in the United States, we find Dr. Lowie expressing a very similar view: "Generally speaking, the unwritten laws of customary usage are obeyed far more willingly than our written codes, or rather they are obeyed spontaneously" ("Primitive Society," chap. on "Justice," p. 387, English Edition). To compare the "willingness" in obedience to law of an Australian savage with a New Yorker, or of a Melanesian with a nonconformist citizen of Glasgow, is a perilous proceeding and its results have to be taken very "generally" indeed, until they lose all meaning. The fact is that no society can work in an efficient manner unless laws are obeyed "willingly" and "spontaneously." The threat of coercion and the fear of punishment do not touch the average man, whether "savage" or "civilised," while, on the other hand, they are indispensable with regard to certain turbulent or criminal elements in either society. Again, there is a number of laws, taboos and obligations in every human culture which weigh heavily on every citizen, demand great self-sacrifice, and are obeyed for moral, sentimental or matter-of-fact reasons, but without any "spontaneity."

It would be easy to multiply statements and to show that the dogma of the automatic submission to custom dominates the whole inquiry into primitive law. Now with this dogma of automatic obedience there are associated certain more special propositions which are universally current in anthropology and yet fatal to the study of primitive jurisprudence.

First of all, if all the rules of custom are obeyed by the savage through sheer inability to break them, then no definition can be given of law, no distinction can be drawn between the rules of law, morals, manners, and other usages. For the only way in which we can classify rules of conduct is by reference to the motives and sanctions by which they are enforced. So that with the assumption of an automatic obedience to all custom, anthropology has to give up any attempt at introducing into the facts order and classification, which is the first task of science.

We have seen already that Mr. Sidney Hartland regards the rules of art, medicine, social organisation, industry and what-not as hopelessly mixed up and lumped together in all savage societies, both in the native's own comprehension and in the reality of social life. He states this view emphatically on several occasions. "... The savage's perception of resemblances differs very much from our own. He sees resemblances between objects which, to our eyes, have not a single point in common" (p. 139). "For the savage ... the policy of a tribe is one and indivisible. ... They [the savages] see nothing grotesque or incongruous in publishing in the name of God a code combining ritual, moral, agricultural, and medical with what we understand as strictly juridical prescriptions. ... We may sever religion from magic, and magic from medicine; the members of the community draw no such distinctions" (pp. 213, 214).

In all this Mr. Sidney Hartland gives lucid and moderate expression to the current views about "primitive prelogical mentality," "confused savage categories," and the general shapelessness of early culture. These views, however, in my opinion, cover but one side of the case, express but a half-truth—as regards law, the views here quoted are not correct. The savages have a class of obligatory rules, not endowed with any mystical character, not set forth in "the name of God," not enforced by any supernatural sanction, but provided with a purely social binding force. The author of "Primitive Law" and most sociologists who share his opinions are not to blame for neglecting these facts of early jurisprudence, for the field-workers have never supplied them with the adequate and relevant material.

In the second place, the dogma of the absolute rigidity of the rules of custom implies an extraordinary over-emphasis of criminal law in primitive communities and a corresponding denial of the possibility of civil law. Absolutely rigid rules cannot be stretched or

adapted to life, they need not be enforced—but they can be broken So much even the believers in a primitive super-legality must admit Hence crime is the only legal problem to be studied in primitive communities, there is no civil law among savages, nor any civil jurisprudence for anthropology to work out This view has dominated comparative studies of law from Sir Henry Maine to the most recent authorities, such as Prof Hobhouse, Dr Lowie and Mr Sidney Hartland Thus we read in the book under review that in primitive societies " the core of legislation is a series of taboos," and that " almost all early codes consist of prohibitions " (p 214) The doctrine that primitive norms of conduct are negative, rigid and religious in character pervades all the book In this again Mr Hartland is not alone Steinmetz in his learned and competent analysis of primitive punishment insists on the criminal character of early jurisprudence, on the mechanical, rigid, almost undirected and unintentional nature of the penalties inflicted and on their religious basis His views are fully endorsed by the great French sociologists Durkheim and Mauss, who add besides one more clause that responsibility, revenge, in fact all legal reactions are founded in the psychology of the group and not of the individual [1] Even such acute and well-informed sociologists as Prof Hobhouse and Dr Lowie, the latter acquainted at first hand with savages, seem to follow the trend of the general bias in their otherwise excellent chapters on justice in primitive societies

Here again, I think that it would be futile to blame these writers, who have treated the material available with all the necessary acumen and the soundest scientific methods It would be also unfair to blame the trained field-worker—often approaching anthropology from natural science or medicine—for his failure to grasp one of the most difficult and slippery problems of primitive sociology I believe, however, that there is a mine of facts still to be worked out in savage communities, which will, when available, force us to recast all current conclusions Primitive law is by no means negative only or even predominantly The positive rules of conduct, the obligations to do, to fulfil are innumerable They are not based on merely religious sanctions, nor is the " group " the focus of all legal forces

In my own studies in north-west Melanesia I have found that human nature always rebels against the rigid letter of the law, that the individual will always stretch the rule or try to evade it—and all this while remaining on the " right side of the law," that is, taking good care not actually to break it Not only that, such attempts are often helped out, abetted by what could be called customary ways of infringement of the law, semi-legalised methods of evasion So that in reality the " cake of custom " is not a uniform crust, evenly pressing its contents, nor is human nature mere dough, which would passively submit to such pressure

The natives will defy law at times, but much more readily they will try to circumvent it The fear or awe of infringing their customs is a figment We read in Mr Hartland's book that " the general belief in the certainty of supernatural punishment and the alienation of the sympathy of one's fellows generate an *atmosphere of terror* which is quite sufficient to prevent a breach of tribal customs " (p 8—the italics are mine) There is no such " atmosphere of terror " unless perhaps in the case of a few very exceptional and sacred rules of ritual and religion, and on the other hand the breach of tribal customs is prevented by a special machinery, the study of which is the real field of primitive jurisprudence In this, as everywhere else, it would be easy to show that Mr Hartland is not to blame for his opinion, but that he has given us a clear and judicious summary of the data available from the best records of field-work

Finally, the fundamental assumption of the rigidity of custom and the savage's automatic compliance with law implies yet one more consequence It renders quite superfluous any attempt at an analysis of the processes of the adjustment of law to life If all custom is always obeyed, and obeyed strictly and automatically, then there is no need to study how the formula of law is being adapted to concrete circumstances All the questions of the latitude, of the laws, of the elasticity of its binding forces of the various re-adjustments and legal compromises must appear to the writers of anthropological jurisprudence as non-existent

To sum up briefly the present state of primitive jurisprudence it is being universally assumed that all custom is law to the savage and that he has no law but his custom All custom again is obeyed automatically and rigidly by sheer inertia There is no civil law or its equivalent in savage societies The only relevant facts are the occasional breaches in defiance of custom—the crimes There is no mechanism of enforcement of the primitive rules of conduct except the punishment of flagrant crime Modern anthropology, therefore, ignores and sometimes even explicitly denies the existence of any social arrangements or of any psychological motives which make primitive man obey a certain class of custom for purely social reasons According to Mr Hartland and all the other authorities, religious sanctions, supernatural penalties, group responsibility and solidarity, taboo and magic are the main elements of jurisprudence in savagery

[1] Steinmetz 'Ethnologische Studien zur ersten Entwickelung der Strafe, 1894 Durkheim in *Ann e Sociologique* i pp 353 sqq , Mauss in " Revue de l Histoire des Religions, 1897

All these contentions are, as I have already indicated, either directly mistaken, or only partially true, or, at least, they can be said to place the reality of native life in a false perspective. Perhaps there is no further need to argue that no man, however "savage" or "primitive," will *instinctively* act against his instincts, or *unwittingly* obey a rule which he feels inclined cunningly to evade or wilfully to defy; or that he will not *spontaneously* act in a manner contrary to all his appetites and inclinations. The fundamental function of law is to curb certain natural propensities, to hem in and control human instincts and to impose a non-spontaneous, compulsory behaviour—in other words, to ensure a type of co-operation which is based on mutual concessions and sacrifices for a common end. A new force, different from the innate, spontaneous endowment must be present to perform this task.

In order to make this negative criticism conclusive, however, it is necessary to add a positive statement of the case, to present the facts of primitive law as it really is, to show in what consists the compulsory nature of primitive legal rules, to lay bare the specific force which makes them into binding law.

The Melanesian of the region which I have studied has unquestionably the greatest respect for his tribal custom and tradition as such. This much may be stated at the outset. All the rules of his tribe, trivial or important, pleasant or irksome, moral or utilitarian, are regarded by him with reverence and felt to be obligatory. But the force of custom, the glamour of tradition, if it stood alone, would not be enough to counteract the temptations of appetite or lust or the dictates of self-interest. Custom is sufficient to carry through the rules of good manner, the rules of order in most situations of daily life or on public occasions—so long as no strong appetite or interest has to be countered. Thus the mere sanction of tradition—the conformism and conservatism of the "savage"—operates often and operates alone in enforcing manners, customary usage, private and public behaviour in all cases where some rules are necessary to establish the mechanism of common life and co-operation and to allow of orderly proceedings—but where there is no need to encroach on self-interest, inertia or to prod into unpleasant action or thwart innate propensities.

There are other rules, dictates and imperatives which require and possess their special type of sanction, besides the mere glamour of tradition. The natives in that part of Melanesia have to conform to a very exacting type of religious ritual, especially at burial and in mourning, and this behaviour is enforced by the special constraint of religious awe and certain definite supernatural and social penalties. There are, again, imperatives of behaviour between parents and children, husband and wife, backed mainly by the natural sentiment of love and affection. There are the rules of art and craft, followed for motives of utility, besides the reverence for tradition. There exists finally the sanction of tribal punishment, due to a reaction in anger and indignation of the whole community. By this sanction human life, property, and, last though not least, personal honour are safeguarded in a Melanesian community, as well as such institutions as chieftainship, exogamy, rank and marriage, which play a paramount part in their tribal constitution.

Each class of rules just enumerated is distinguishable from the rest by its sanctions and by its relation to the social organisation of the tribe and to its culture. They do not form this amorphous mass of tribal usage or "cake of custom" of which we have been hearing so much. The last category, the fundamental rules safeguarding life, property and personality form the class which might be described as "criminal law"—very often over-emphasised by anthropologists and falsely connected with the problem of "government" and "central authority" and invariably torn out of its proper context of other legal rules. For—and here we come at last to the most important point—there exists a class of binding rules which control most aspects of tribal life, which regulate personal relations between kinsmen, clansmen and tribesmen, settle economic relations, the exercise of power and of magic, the status of husband and wife and of their respective families. These are the rules of a Melanesian community which correspond to our civil law.

There is no religious sanction to these rules, no fear, superstitious or rational, enforces them, no tribal punishment visits their breach, nor even the stigma of public opinion or moral blame. The forces which make these rules binding we shall lay bare and find them not simple but clearly definable, not to be described by one word or one concept, but very real none the less. The binding forces of Melanesian civil law are to be found in the concatenation of the obligations, in the fact that they are arranged into chains of mutual services, a give and take extending over long periods of time and covering wide aspects of interest and activity. To this there is added the conspicuous and ceremonial manner in which most of the legal obligations have to be discharged. This binds people by an appeal to their vanity and self-regard, to their love of self-enhancement by display. Thus the binding force of these rules is due to the natural mental trends of self-interest, ambition and vanity, set into play by a special social mechanism into which the obligatory actions are framed.

It is quite clear, I trust, that none of the criticism of this review is levelled against Mr. Sidney Hartland's

own contributions to the problem His book is not only a most learned and brilliant achievement, it comes also most useful and handy in the present state of our knowledge, for it is a veritable masterpiece of lucid, competent, thorough synthesis of past and contemporary researches and theories of primitive law Mr Sidney Hartland is one of the great representatives of the comparative school of anthropology, and, like some other writers of this school, he has been able to vindicate the claims of anthropology to be a genuine science in that he foretold discoveries not yet made at that time In his Legend of Perseus and his subsequent work of first-class value he has given new and most illuminating contributions to the study of primitive kinship His "forecast of primeval past," as we might call it perhaps, about the primitive ignorance of paternity has been proved in the discoveries of Spencer and Gillen in Australia, and of the present reviewer in Melanesia His new work deserves to rank among the best recent contributions to anthropology it should be read by all those students who recognise that our science has not done justice to the study of primitive law and by all the observers of savage races who wish to work out what will prove, perhaps, the most fertile plot of their field B MALINOWSKI

The Metaphysic of Science

The Metaphysical Foundations of Modern Physical Science a Historical and Critical Essay By Prof Edwin Arthur Burtt (International Library of Psychology, Philosophy and Scientific Method) Pp ix+349 (London Kegan Paul and Co, Ltd, New York Harcourt, Brace and Co, Inc, 1925) 14*s* net

PROF BURTT has given us a study of the history of modern science from an unusual but very important point of view He has sought to lay bare the principle underlying and directing scientific discovery rather than to chronicle the discoveries in their objective and practical aspect He finds that the metaphysic of science when it is laid bare is neither self-evident nor consistent, but in fact highly paradoxical In his concluding chapter he invites men of science and philosophers to study this metaphysic critically with a view to its fundamental reformation It is the metaphysics of Newton

"Wherever was taught as truth the universal formula of gravitation, there was also insinuated as a nimbus of surrounding belief that man is but the puny and local spectator, nay irrelevant product of an infinite self-moving engine, which existed eternally before him and will be eternally after him, enshrining the rigour of mathematical relationships while banishing into impotence all ideal imaginations, an engine which consists of raw masses wandering to no purpose in an undiscoverable time and space, and is in general wholly devoid of any qualities that might spell satisfaction for the major interests of human nature, save solely the central aim of the mathematical physicist"

It is a curious thing that Newton, whose fame in the first half of the eighteenth century as the representative English philosopher resounded throughout the learned world, finds no place in any of the standard histories of philosophy Voltaire's "Elemens de la philosophie de Newton" was not only widely read but also chiefly instrumental in dethroning the Cartesians and Leibnizians and preparing the stage for empiricism, positivism, and scientific realism Neither by ourselves nor by others, however, is Newton now placed in the line of the historical philosophical development, he is always ranked as a pioneer of science, deriving his lineage from Copernicus, Galileo, and Kepler Yet to his contemporaries, to Leibniz, Locke, and Berkeley, he was primarily a metaphysician, and to Kant in the later eighteenth century Newton's concepts of space and time set the task of the transcendental æsthetic

It is only in recent times, in fact since the nineteenth century advance of the physical sciences, that the history of thought has undergone retrospectively a bifurcation into science and philosophy The ground or reason of the separation, and for placing Newton in the line of science as opposed to the line of philosophy, was largely the consequence of Newton's own attitude towards physical problems To emphasise the value of experiments he seemed to decry the method of logical deduction and the appeal to the criterion of consistency His "physics beware metaphysics" and his "hypotheses non fingo" were everywhere quoted to deprecate philosophical speculation Then, in opposition to this provocative attitude to philosophy, Hegel was aroused to his contemptible reference to the use of the term "philosophical" which the English, he said, employed to describe scientific instruments There is a great change in our thought to-day We are discovering that the divorce between physics and metaphysics is not only irrational but also disastrous, alike in the interests of philosophy and science

Prof Burtt brings out in a very striking way the interesting contrast between the mathematical principle which underlay the philosophy of Descartes and his followers in France and the physical principle which predominated in all the seventeenth-century philosophies in England There was, however, one important thing common to both lines and to both principles In whatever way philosophers conceived the absolute in Nature, whether as a mathematical or as a physical principle, whether under the form of extension or under the form of ether, it was

never conceived abstractly, for it was always correlated with the concept of God For example, Newton's absolute space and time are God's sensorium, Berkeley's absolute *esse* is God's *percipi* Now the absolute of modern science, the real world of physics, is, on the other hand, the concept of an abstract reality, conceived as existing in itself even if there be no God and whether there be one or not It is this abstract absolute which has been tried and found wanting by the contemporary relativists The principle of relativity tells us that there is no world which is no one's world, no space-time which is not some one's space-time The space-time and the ether which are the common world, the world to which our mathematical equations and our physical concepts apply, are a function of the intercourse of observers of Nature co-ordinating their universe each from the point of view of his own system chosen as a frame of reference It is impossible to visualise the ultimate reality of physics because it does not originate in a sensible image but in a mathematical formulation It is by active measurements that the reality of physics is provided to science

Prof Burtt concludes his most instructive historical and critical review by exposing the extraordinary difficulties of the epistemological theory based on the Cartesian dualism of mind and body, a dualism which in one form or another has persisted throughout the modern period H WILDON CARR

An American View of the Agricultural Situation

The Agricultural Situation Economic Effects of Fluctuating Prices By Prof G F Warren and Prof F A Pearson (The Price Series) Pp xvi+306 (New York J Wiley and Sons, Inc, London Chapman and Hall, Ltd, 1924) 15s net

TO many in Great Britain it will come as somewhat of a surprise to learn that the American farmer finds almost as much difficulty as the British farmer in making both ends meet indeed, so far as comparisons are possible, he seems to be in a worse plight There are no better qualified men on this subject than Profs Warren and Pearson, and they give in this book a very clear exposition of the situation, but the picture is far from rosy and the authors close on a pessimistic note they see no easy way out of the difficulty

The trouble arises from the low price received by the farmer for his products in comparison with the high price he has to pay for services and materials received It required twice as much farm produce to pay the taxes, interest charges, and labour in 1922 as it did before the War Labour has unfortunately not become more efficient, and farm production has not increased There are two obvious remedies farmers might combine and obtain for themselves the same degree of profit that the skilful middlemen in the cities manage to secure or they can reduce production Combination among farmers for selling has hitherto proved very difficult, though it is now being tried in Canada reduced production is the more certain method, but the authors recognise that it is undesirable As we read the book, we feel that the remedy, even if successful in curing the farmers' ills, would leave the world worse off than before The authors show that part of the farmers' difficulties arise from the poverty of many people in Europe instead of eating wheat and meat they live on potatoes and vegetables, and if the prices of farm commodities rose still further, these unfortunate people would be still worse off

The authors attach more importance to economic adjustment of prices than to scientific advances in methods of production Indeed they show that plant diseases, insects, and unfavourable weather may even help some farmers by temporarily forcing up prices Time is the great healer and the only consolation in the present position is the authors' clearly expressed view that "when a period of agricultural depression ends, a period of agricultural prosperity follows" We should have liked the authors' opinions on the method that British scientific workers are advising farmers to adopt an increase of farm produce per unit area so as to obtain the extra sacks of corn needed to meet the extra charges Great Britain differs from the United States in importing a great amount of food annually An increased home production in Britain would lessen the need for imports In the States, however, a great amount of food is already exported and for any extra production an outlet must be found

The agricultural student will find the book unusually interesting and stimulating, and its value is enhanced by the number of curves and diagrams presenting the statistical data in a form easily grasped by the reader

E J R

Popular History of Astronomy

Histoire de l'astronomie Par F Boquet (Bibliothèque scientifique) Pp 510 (Paris Payot et Cie, 1925) 25 francs

THERE seems to be a demand in France for popular books on the history of astronomy, as we reviewed a book with the same title, by E Doublet, a little more than two years ago (vol 110, p 600), and a similar work by E Lebon was published in 1899 M Boquet does not pretend to have studied the original works of astronomers of past ages, nor the

extensive literature of monographs on special subjects He merely claims to give a resume of a number of books, of which he gives a list His authorities range from original and valuable works like those of Delambre, Grant, and others, down to popular and uncritical books which he would have been better without For to M Boquet all authors of printed matter seem to be equally authoritative, and whenever they differ he leaves the decision as to who is right to the reader An amusing example of this helplessness is found on p 254 When speaking of Copernicus, the author says that "during the campaign of 1805, some authors say 1806, Napoleon visited the house in which Copernicus was born" Surely it would have been easy to find out whether Napoleon was in Prussia in 1805 or not As a matter of fact his visit to Thorn was in 1812 There are a great many cases like this throughout the book The readiness of the author to accept any statement as true, no matter by whom it is made, so long as nobody has been of a different opinion, lets him accept as authentic the picture of "the well of Eratosthenes" published in 1914 in the *Observatory* magazine, as he has overlooked a refutation given in the same volume, and so in many other cases

The greatest fault of this book is that it devotes far too much space to astronomers who were not of the first rank or even of the second, and far too little to the great leaders Information of the kind given might have made the book useful as one of reference, if it had been provided with a good index But there is no index, and even the table of contents is very meagre, filling only one page Any one hoping to find an account of how our knowledge of the motions and nature of the heavenly bodies has been gradually developed, will be disappointed The author allows almost exactly the same amount of space, seven pages, to each of the greatest astronomers, except to Hipparchus and Ptolemy, to whom he gives a page or two less, because we do not know anything about their lives Under Hipparchus, as everywhere else, we find old statements repeated, though they have been refuted It was not a new star but a comet which appeared in 134 B C, and the catalogue of Hipparchus did not contain 1080 stars, but only about 850, a matter of some importance, as it helps us to realise that Ptolemy did not simply borrow all his star-places from Hipparchus M Boquet is aware that Laplace recognised Ptolemy's catalogue as an independent work, but as usual he does not enter into details, and simply says "Il est difficile de conclure" How the epicyclic system began and how it was gradually improved until it became the complicated Ptolemaic system, is not described Similarly, under Copernicus nothing is said as to how he came to discover the motion of the earth, except that we might as well ask why a genius is a genius "Ici la reponse est difficile" The same is the case when we come to Newton, but here at any rate we find some new information It appears that Newton competed for a fellowship and obtained eleventh place among eleven candidates One must agree with M Boquet, when he says that it was not very brilliant But where did he get that story from? It is also news to us to hear that it is not known when Newton wrote the "Principia" After that, the reader is prepared to meet with the old fables, how Newton did not know of Picard's results as to the size of the earth until 1682, and how he went mad ten years later, and so on

J L E D

Our Bookshelf

Alpine Flora for Tourists and Amateur Botanists with Text descriptive of the most Widely Distributed and Attractive Alpine Plants By Dr Julius Hoffmann Translated by E S Barton (Mrs A Gepp) New edition Pp xiv + 121 + 43 plates (London Longmans, Green and Co, 1925) 12*s* 6*d* net

A NEW edition of Mrs Gepp's English translation of this well-known flora will be welcomed by many to whom, though not themselves botanists, the flora of the Alps makes an irresistible appeal The book itself is a tourists' flora rather than a scientific work It aims at affording a ready means of recognising the more conspicuous or characteristic species of the Central European Alps—not merely the Swiss Alps It lacks the "keys" to genera and species found in more scientific floras, such as Schinz and Keller's "Flora der Schweiz," and, for purposes of identification, frankly relies, in the first instance, on its 43 coloured plates, on which the great majority of the species described are figured Within the limits determined by the plan of the book, the brief descriptions in the text are good Detailed floral structure is omitted, the diagnostic characters employed being for the most part those of habit, size, leaf, and perianth Simple technical terms are freely used, but as there is an adequate glossary, amateurs should experience little difficulty A slip occurs in the description of the species of Anemone, the perianth being referred to in one case as "sepals," and in another as "petals"

Useful notes on distribution, habitats, and altitudes are given On the whole, the figures give sufficiently accurate representations of the plants for purposes of not too critical identification The colouring, if a little crude, is distinctly better than that found in many similar works As is to be expected, the success of the colouring varies a good deal The colours of *Gentiana acaulis*, for example, have been very fairly reproduced, but one misses the wonderfully haunting blue of *G bavarica* In comparatively few examples (*e g* on plates 5 and 26) have fruits been figured some others, such as the very characteristic plumed fruits of *Dryas octopetala*, *Geum montanum*, and *G reptans* might well have been included In the case of very small flowers, too, the addition to a habit figure

of a single enlarged flower (as has been made in a very few cases) would be a decided advantage

In the present edition one of the original plates has been omitted, but four new ones (including selected rushes, sedges, grasses, ferns, lycopods, mosses, and lichens) form a useful addition The book is well printed, but is perhaps unnecessarily heavy, considering that it is intended as a travelling companion for tourists, a lighter paper might have been used The publishers would also do well to look more carefully to the binding the pages in the review copy show an alarming tendency to break loose from their moorings

The Chemistry of Enzyme Actions By K George Falk (American Chemical Society Monograph Series) Second and revised edition Pp 249 (New York The Chemical Catalog Co, Inc, 1924) 3 50 dollars net

THIS book retains the main features of the first edition, although it has been approximately doubled in size Enzyme actions are considered so far as possible as ordinary chemical changes, and the author's views on the theory and mechanism of chemical reactions are applied to them A preliminary study of his book on this subject would probably be of advantage to the reader, as the sketch of the subject in the introduction to the present work suffers from enforced condensation Briefly stated, the author is a strong supporter of the addition theory of chemical change The mode of treatment renders the book rather difficult reading, but there is a constant appeal to the critical faculty which stimulates the reader's interest

A good account of the recent work bearing on the vexed question of the chemical nature of enzymes is given, including the author's suggestive experiments on the selective action of ester-hydrolysing substances, made to glean indications regarding the chemical nature of the lipases The whole problem is still in its infancy, and a consideration of the general physical and chemical properties of the enzymes leads only to the tentative generalisation "that an enzyme action is due to a chemical grouping of marked instability present in a complex molecule of colloidal nature" The colloidal character of all known enzymes is thus recognised but is kept carefully in the background in the author's consideration of the nature of enzyme action, since he believes that "fundamentally the chemical reactions of a substance are based upon its chemical properties," although its physical state will naturally modify the relations observed He even holds out the hope (p 233) of being able to obtain the "enzyme property" in a crystalloidal or readily dialysable form, thus abandoning the tentative suggestion just recorded

A somewhat sketchy chapter on the uses and applications of enzymes and a long and detailed account of experiments on enzyme actions of tissues and tumours—the treatment of which is quite out of proportion to that of the rest of the work—are also included in the book, which concludes with a summary of the present status of the enzyme question

As will be seen, the work is one only for the advanced student or investigator, who is able by the exercise of his critical faculty to enjoy the somewhat novel presentation of familiar facts A H

Bismuth Ores By Robert Allen Pp ix+62 3*s* 6*d* net *Antimony Ores* By Edward Halse Pp ix+102 5*s* net *Bauxite and Aluminium* By W G Rumbold Pp ix+110 6*s* net (Imperial Institute Monographs on Mineral Resources with special reference to the British Empire) (London John Murray, 1925)

THE above three volumes issued by the Imperial Institute form a further contribution to the series of monographs on mineral resources which the Institute has issued from time to time, and these follow closely the lines upon which their predecessors have been laid down Each book consists of three sections, the first dealing with the characters and composition of the ores of the metal treated of, the uses and properties of the metal and of its more important alloys, and the metallurgy of the metal, that is, the processes by which it is extracted from its ores The second section gives an account of the distribution and occurrence of the ores of the metal within the British Empire, these occurrences being described in some little detail, the third section describes the sources from which the ores of the metal in question are obtained from foreign countries, that is to say, countries outside of the British Empire Statistics of production are usually given, though these are to-day of comparatively little importance in view of the fact that full official statistics are published regularly by the Imperial Mineral Resources Bureau Each volume, however, concludes with a very useful bibliography of the metal to which the volume refers

With regard to the individual volumes themselves, there is little to be said It so happens that the production of each one of the three metals here discussed is in relatively few hands, and that there is accordingly a certain amount of secrecy concerning the processes of extraction employed, their general principles being of course known, though many of the minute details are looked upon as trade secrets, it need scarcely be said that it quite often happens that these minor details may make all the difference in the economic success or failure of a process In every case the work appears to have been done carefully and painstakingly, and appears to be upon the whole quite accurate No doubt the information given would not be sufficient for the specialist, but the object of these books is not to provide information of that type, but rather to give a general survey of the subject which will suffice for the objects of the average inquirer, and this purpose is quite well fulfilled by the books before us It must often happen that the business man requires some general knowledge of the origin and mode of distribution of the materials in which he deals, and the object of these monographs is to supply information of that kind

Anthropology By Prof A L Kroeber Pp x+523 (London, Calcutta and Sydney George G Harrap and Co, Ltd, n d) 12*s* 6*d* net

THE professor of anthropology in the University of California has written a notable book—one which deserves to be known and studied in Europe as well as in America He seeks to provide answers to the questions When and where did the races of mankind

become differentiated? When and where did they come by their languages? When and where did they acquire their customs, beliefs and ways of living and their manner of doing things? He does not answer these questions by culling quotations from authorities, but, using his well-stocked mind, a wide personal experience, a sane judgment, and a happy gift of expression, returns answers that all who read may understand and, at the same time, feel that they are in touch with the live problems of anthropology His main aim is to explain how peoples in every land have come by their cultures, particularly how the peoples of the New World, both ancient and modern, came by theirs

Amongst European anthropologists, that school which regards inventions, beliefs and practices, now widely spread amongst living peoples, as having arisen in single centres, is gaining adherents every day Prof Kroeber, while open to the fact that cultures do often spread by borrowings and by migrations, champions the cause of independent and multiple origins The practice of the *couvade* prevailed in Europe and Brazil That fact is construed by the growing school as evidence that there had been a culture drift from the Old World to the New Prof Kroeber, from the same facts, draws the inference that the natives of Europe and the natives of Brazil were provided with a common impulse, and that under the influence of this impulse they devised a common practice Although the reviewer's sympathies are altogether against "independent origins," it is well that "migrationists" should be thoroughly acquainted with the other side of their case They will find that Prof Kroeber has culled much from the ancient civilisations of Mexico, Maya and Peru which deserves their serious consideration Beyond all this, the book is one of the most comprehensive and attractive of text-books on anthropology

Chronique des evénements météorologiques en Belgique jusqu'en 1834 Par E Vanderlinden Pp 329 (Bruxelles M Hayez, 1924) 16 francs

REGULAR meteorological observations are of comparatively recent origin, but mankind has always been interested in the weather, and numerous meteorological references are scattered through the literature of all countries from the earliest times The importance of collecting these records has been recognised by the International Meteorological Committee, and in recent years several eminent meteorologists have occupied themselves with the task, especially the late A Angot in France and G Hellmann in Germany Last year Sir Richard Gregory presented us with a summary of the early meteorological records of the British Isles, and we have now to welcome an exhaustive compilation of the material from Belgium by the veteran meteorologist, E Vanderlinden, commencing with the record of a rainy summer in the year A D 120, and continuing until the beginning of regular meteorological observations at Brussels in 1834

The records deal with mild or severe winters, dry or rainy summers, early or late frosts, floods and storms, the most valuable are those which were recorded owing to their agricultural importance It is interesting to notice that the author recognises three stages in the recording of meteorological notes, in the most ancient medieval chronicles the remarks are generally brief and to the point—"severe winter" Later they become longer and more fanciful, often verse is employed In the third stage the facts are distorted to fit the narrator's theories or his love of the marvellous, and it is not until the end of the eighteenth century that a scientific character is recovered The usual historical difficulties were met with, especially in the dating of events which occurred in winter, but the author appears to have performed the critical part of his work with good judgment The documentation is excellent, for each year, after a brief summary of the phenomena in French the original remark is quoted, followed by a reference to the chapter and page of the authority At the end of the work the principal phenomena are tabulated

Einfuhrung in die allgemeine Kohlenpetrographie Von Dr Robert Potonie Pp x+285 (Berlin Gebruder Borntraeger, 1924) 13*s* 2*d*

THIS work is not only of importance in itself, but also derives considerable interest from the fact that it embodies the continuation, by a distinguished son, of work commenced by a distinguished father, for Henry Potonie's work on the structure of coal may be regarded in many respects as a classic The author describes the object of the work by quoting a definition of Weinschenk to the effect that petrography considers the origin, the characteristics, and the mode of decomposition of rocks, and notes that, from this point of view, but little attention has been paid to the study of coal, so that the petrography of coal is still in its infancy He further quotes a sentence from Dannenberg to the effect that, for practical purposes, distinctions drawn from a mineralogical or petrological point of view are of but little importance, but he shows that this statement is only true because so little has been done towards the scientific study of the subject of the present book

Dr Potonie discusses first the modes of formation of coal, the macroscopic structure of coal and its origin, the microscopic structure of coal and its causes, and then, in some detail, the petrographic constituents of coal, and the various materials from which these have been built up It need scarcely be said that a very large number of the views which he sets forth will not be universally accepted, our knowledge of the subject being in fact too imperfect to admit as yet of anything like finality, but the book before us undoubtedly constitutes a very important contribution to the study of a subject which is not only of profound scientific interest, but also may well prove to have very important practical bearings

The Student's Handbook of British Mosses By H N. Dixon Third edition, revised and enlarged Pp xlviii+582+63 plates (Eastbourne V V Sumfield, London Wheldon and Wesley, Ltd, 1924) 24*s*

THIS well-known work has now been re-issued in a third edition which will prove very welcome to bryologists Thinner paper, improved type, and new drawings for many of the plates serve to make the volume both of more convenient size and also more attractive Much new material has been incorporated

embodying the essence of recent work on this subject The glossary and instructions are fuller, and more conveniently placed in reference to the illustrations, while the plates contain a large number of additional details This is especially noticeable in the illustrations of Bryum, where capsules are now figured for most of the species *Bryum purpureum* on Plate XLII should, however, presumably be *B purpurascens*, and there are also slips in the lettering of Plates XII and XVII In the former case (Campylopus) the figures lettered A to E should be C, D, E, A, and B, while in the latter case (Fissidens) the plates D, E, and F are incorrectly described at the foot of the page, although correct in the text Slight modifications have been made in the treatment of the Sphagna, Dicranum, and Thuidium Stirton's names are indicated in the synonymy where necessary, but the previous treatment of these names has not always been maintained *Zygodon teichophilus* Stirt is now given as *Z lapponicus* instead of *Z Stirtoni* (as in the *Journal of Botany*, 1923, p 69), while *Mollia thrausta* Stirt, p 245, is not now taken as equivalent to *Trichostomum tortuosum* var *fragipolium* The quality of the book is quite maintained at its former high and critical standard, and it will continue to be invaluable to workers in this field

Industrial Electricity By Prof Chester L Dawes (Electrical Engineering Texts) Part I Pp xiv+371 (New York McGraw-Hill Book Co, Inc, London McGraw-Hill Publishing Co, Ltd, 1924) 11*s* 3*d* net

MANY technical high schools in America have elementary electrical engineering courses This book has been written for the use of students attending these courses and the author has done his work well The explanations are clear, and the machines described are all in everyday use The first five chapters give a good grounding in the elementary principles of magnetic and electric circuits, a large number of illustrative problems being given to show concrete applications of these problems The rest of the book gives a bird's-eye view of electrical engineering Owing to the great industrial importance of batteries, as, for example, in radio work and for motor-cars, we are glad that due space has been allotted to describing their underlying principles and how to maintain their efficiency and life A typical ignition system and a typical lighting and starting system for motor-cars are also fully described The next volume will discuss direct and alternating current power distribution The author perhaps states a fundamental law of electrostatics too dogmatically "For every positive charge in the universe there must exist an equal negative charge" It is a bold thing to draw conclusions about the universe from our terrestrial experiments

Die Schollen der norddeutschen Moranen in ihrer Bedeutung fur die diluvialen Krustenbewegungen Von Dr Georg Petersen (Fortschritte der Geologie und Palaontologie, Heft 9) Pp iv+179-274+1 Tafel (Berlin Gebruder Borntraeger, 1924) 6*s* 9*d*

Low level glacial deposits often include large transported masses which are known in Germany as a variety of "Schollen" They there consist of sedimentary blocks ranging in age from the Jurassic to Glacial The majority belong to strata from the Chalk to the Miocene These glacial Schollen have been catalogued and described in an admirable monograph by Dr Georg Petersen of Trier He deals with 459 examples, including a few from Russia and Denmark 205 of them have been discovered by bores, the remainder are exposed in cliffs and quarries or on the surface The largest is a sheet of chalk at Sternitten in Samland, which is 4 km long by 2 km wide and 14 to 20 m thick The great majority of those measured are less than 10 m long The Sternitten Scholl has been carried 4 km from the bed of the Baltic As a rule they have been transported a short distance, but one near Leipzig has apparently been brought from Rugen The author attributes the transport to glacial action, and directs attention to the view of Prof Keilhack, who has pointed out their resemblance to the results of drifting ice-floes in the Baltic during severe winters A special feature of the monograph is the author's view that the Schollen afford evidence of widespread Pleistocene earth-movements in North Germany

Der mittlere Jura im Hinterlande von Daressalaam (Deutsch-Ostafrika) Beitrage zur Geologie und Stratigraphie Deutsch-Ostafrikas III Von Edwin Hennig (Monographien zur Geologie und Palaontologie Serie 2, Heft 2) Pp iv+131+4 Tafeln (Leipzig Gebruder Borntraeger, 1924) 33*s*

THE Jurassic geology of East Africa affords the main evidence as to the early history of the western part of the Indian Ocean Hence every addition to the scanty fauna of the East African Jurassic is of importance Prof Edwin Hennig, well known from his "Geology of Wurttemberg" and his contributions to the great monograph on the Tendaguru beds of East Africa, in this monograph describes a miscellaneous collection of fossils from several localities between 70 and 90 miles west of Dar-es-Salaam along the railway to Lake Tanganyika The fossils are mainly lamellibranchs, of which three new species are described The horizons are assigned by Prof Kennig to a continuous series from the Aalenian to the Oxfordian He recognises that the material is inadequate for these determinations to be free from doubt, but they are consistent with the sequence of localities In considering the affinities of the fauna he refers to those of Madagascar and India, but does not mention the later literature on the contemporary fossils of Kenya Colony The price of the book is 33 shillings, which for a paper-bound booklet of 131 pages with 4 cheaply produced plates is very high

Elementary Physics for Medical, First Year University Science Students and general Use in Schools By G Stead Pp xiv+453 (London J and A Churchill, 1924) 10*s* 6*d* net

IT is quite safe to predict that this book will be much used by medical students, for whom it is primarily intended, for it would be difficult to find one better suited to their peculiar requirements The mathematics has been reduced to a minimum, and the presentation is probably as attractive as it can be made to students who are not as a rule prepared to take their physics very seriously, that is to say, who are somewhat averse from hard thinking and clear

reasoning It is very well printed and illustrated, and is remarkably good value

As a text-book for the general science student it is perhaps a trifle less satisfactory The logical development is not always above criticism, as, for example, in the introductory paragraph of the section on heat, where the idea of quantity of heat is invoked in order to explain that of difference of temperature Again, the theoretical justification of Archimedes' principle is not clearly set forth, and it is to be feared that the explanation of Newton's Third Law will leave the student just where he was in his acquaintance with those mysterious twins—action and reaction Apart from these and one or two other exceptionable items, there is little to criticise and much to commend

Radio, Beam and Broadcast its Story and Patents By A H Morse Pp 192 (London Ernest Benn, Ltd, 1925) 12s 6d net

THE author gives a good account of the art of radio-communication In an appendix he quotes British and American patent specifications or gives extracts from them describing the main steps in the evolution of the art Many wonderfully accurate guesses into the future have been made, but few are so wonderful as Du Maurier's drawing published in *Punch* of 1878 of what appears to be an elaborate home radio set and a lady telling her page-boy to turn on the tap for the concert from Covent Garden, etc, at stated times in the evening Long-distance broadcasting was anticipated, as one of the panels is marked "Bayreuth" In 1892 Sir William Crookes, in a paper in the *Fortnightly Review*, makes an excellent forecast of radio-telegraphy, suggesting that 50 yards would be a suitable wave-length, and that the instruments for reception would have to be tuned to this wave-length We are inclined to agree with the author that, in the near future, broadcasting of local urban interest only will be effected over existing telephone or lighting wires and so kept out of the ether The ether is already becoming congested, mainly due to broadcasting A single broadcasting station takes as much of the ether as would accommodate at least ten radio-telegraph stations

Why the Weather? By Dr Charles Franklin Brooks, with the Collaboration of John Nelson and others Pp xvi+310+21 plates (New York Harcourt, Brace and Co, 1924) n p

THE aim of this book is to present the elements of the physics of the atmosphere in a simple manner It covers rather a wide field, and does not delve very deeply into any portion of the subject The style is chatty, rather than simple, and gives the impression that the author has made a too strenuous effort to write down to the level of his public While the author states a number of facts which would be unknown to the general reader, his theory is not always reliable For example, he ascribes the "table-cloth" on Table Mountain to the cooling effect upon the air of the low temperature of the mountain top, instead of to adiabatic cooling of the air blown up the slopes of the mountain It is stated that the earth has grown from a comparatively small cold body by the addition of mass by showers of meteors falling upon it, a theory which is by no means so widely accepted as might be inferred from the author's bold statement of it On the whole, the book can be recommended to the general reader as an introduction to the physics of atmosphere The illustrations, mainly of cloud forms, are very well selected

Studies in the History of Political Philosophy before and after Rousseau By Dr C E Vaughan Edited by A G Little Vol 1 *From Hobbes to Hume* Pp xxix+364 Vol 2 *From Burke to Mazzini* With a list of the Writings of Prof Vaughan, by H B Charlton Pp xx+6+339 (Manchester At the University Press, London Longmans, Green and Co, 1925) 2 vols, 42s net

THESE volumes will be valued by all those who knew or who passed under the influence of the distinguished professor who held the chair of English first at Cardiff, then at Newcastle, and later at Leeds before he died in 1922 The books and articles published by him in his lifetime were all of the nature of students' manuals or were aids to study Apart from his work in the class-room, he was engaged throughout the active period of his life in writing a "History of Political Philosophy," and the studies for this, some of which were left in a finished, others in an unfinished, condition, but none of them marked for press, have now been edited and published The whole is a monumental work of the first importance

The Races of Man and their Distribution By Dr A C Haddon New edition Pp viii+184+10 plates (Cambridge At the University Press, 1924) 6s net

THIS is a new edition, entirely rewritten, of a small and very useful volume by the pioneer field-worker and veteran anthropologist of Great Britain In its present form the book is the best succinct statement of the principles of racial classification, of the physical characters of each stock, and of the distribution of the varieties of man In the analysis of the concept of "race" and the discussion of the main criteria of physical anthropology, which form the first part of the volume, the modern theories and points of view of cultural anthropology have been taken into account In the description of the main races which follows, the book does not go beyond the limit of physical anthropology Within these, it is the best and most authoritative statement of the subject Mainly designed as a text-book for the beginner and the general reader, it will be also valuable as a handy work of reference for the specialist

The Match Industry its Origin and Development By W H Dixon (Pitman's Common Commodities and Industries Series) Pp x+150 (London Sir Isaac Pitman and Sons, Ltd, 1925) 3s net

THE author gives an interesting account of the manufacture of matches The style suffers owing to the breaking up of the text into a large number of very short paragraphs, generally single sentences The historical part is incomplete and disconnected, and in future editions more attention might be given to this side, and in particular the claims of Walker should be more critically examined

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Ionisation produced in Air during the complete Absorption of Slow Electrons.

A DIRECT determination of the average number of pairs of ions produced by a slow electron of given initial velocity during its complete absorption in a gas has been made possible by the use of high-speed pumps. Electrons are accelerated from a tungsten filament and passed through a capillary tube into an ionisation chamber containing gas at a suitable pressure, the gas issuing from the capillary being removed fast enough to maintain a good vacuum near the filament. The number of electrons entering the ionisation chamber is measured by a movable Faraday cylinder placed inside the chamber very close to the end of the capillary; then after the cylinder has been removed from the path of the beam, the ionisation produced in the gas is determined in the usual way.

If all the electrons had the same energy at the moment they leave the capillary tube, the ratio of the number of ions to the number of electrons would give the average ionisation produced by each electron, the initial energy being determined by the accelerating potential. In practice it was found impossible to obtain a homogeneous beam, and the present experiments were carried out with beams in which from 40 to 80 per cent. had velocities corresponding to the full accelerating potential, while the remainder were slow compared with these. The homogeneity was determined for each experiment, *in vacuo*, by applying retarding potentials to the Faraday cylinder.

The values found experimentally for the number of ions per electron are therefore too low. A first approximation to the true value may be obtained by increasing the experimental values by a factor $100/P$, where P represents the percentage of full-velocity electrons in the beam. When this is done, it is found that the ionisation per electron in air increases steadily with the initial energy of the ionising electron over the range from 100 to 1000 volts. Although the experimental error was certainly not more than 10 per cent., uncertainties in the composition of the beam gave rise to a possible error in the corrected values of the order of 20 per cent. The following table gives mean values:

Initial Energy of Electron in Volts.	Pairs of Ions produced in Air.	Energy expended per Ion Pair in Volts.
200	5·8	35
400	14·5	28
600	24	25
800	35	23
1000	45	22

It will be observed that the average energy expended per ion-pair decreases towards the ionisation potential (17 volts) as the initial energy of the ionising electron increases, and over this range is less than any value previously published. It is, however, comparable with that found by Geiger (33 volts) from measurements on α-particles, where most of the ionisation is due to δ-rays. The behaviour of helium is similar, the energy expended per ion-pair in this case attaining a value much closer to the first ionisation potential (25 volts) than in air, from which it follows that, in this gas, very little energy can be lost in non-effective collisions.

J. F. LEHMANN.
T. H. OSGOOD.

Cavendish Laboratory,
Cambridge, August 3.

Lightning conductors.

"WHO would have thought that man would succeed in drawing off the lightning and conducting it to an outlet?" The quotation is taken from one of a series of small octavo volumes written certainly by one intimately acquainted with his subject, and published anonymously in Amsterdam in 1782–3 under the title "Tableau de Paris." The date, which is within about ten years of the "Terror," seemed to promise matter of interest to the student of the French Revolution, and the expectation proved to be amply justified. While the work necessarily contains much that is a sinister omen of approaching catastrophe, it also covers a wide and diversified field of contemporary life and thought; and, in particular, it contains many evidences that a very fine spirit of experimental and speculative research was awake in the France of that period. Each *tableau* has a short chapter to itself, the above quotation being taken from one headed "*Para-tonnerre.*" The author's satisfaction with the new discovery would perhaps have been considerably tempered had he known that nearly a hundred and fifty years later the solution of the problem of defence against lightning would be recognised as still far from complete, that the control of the thunder-bolt would furnish cause for anxious study to the scientists of the twentieth century.

In view of the recent severe thunderstorms, the detailed description given of the earliest lightning-conductors erected in Paris may be of interest:—

"These great pieces of apparatus, which modern physics has designed to protect buildings from lightning, are numerous in many towns in the heart of the provinces, but they are rare in the Capital. The Abbé Bertholon, professor of experimental physics of the States-General of Languedoc, showed the greatest zeal in opposing the weapons of science to the attacks of lightning. It was he who superintended the construction of the first lightning-conductors in Paris—an honour due to one who had already erected the superb *para-tonnerres* at Lyons. There are now two to be seen, one placed on the Hôtel de Charost, faubourg Saint-Honoré. It is 185 feet long, while the part in the earth, terminating in water, has a depth of 28 feet. The second is at the other end of Paris, on the convent of the *religieuses augustines Anglaises*. It is 188 feet long; and the portion buried in the earth, which dips under water at the end, has a depth of 90 feet—a depth with which no other lightning-conductor of this kind can be compared."

"The pieces composing this apparatus are joined together with long screws [*à vis profondes*] and the precision of the work is such that all the bars seem to be one piece. Metallic connections, skilfully arranged, are put wherever necessary or useful [*Des communications métalliques, savamment ménagées, se trouvent dans les endroits où elles sont nécessaires ou utiles*]. Thus the lightning has to obey the Abbé Bertholon, and follow the direction which he has prescribed."

Unfortunately, the kind of metal used is not mentioned. One is inclined to think, however, that if copper rods were employed this would not have escaped the writer's notice. This rather doubtful consideration would seem to indicate that the material was probably iron. It is significant, also, that no claim is made on the Abbé Bertholon's behalf, with

respect to the *invention* of the 'lightning-conductor" Franklin whose first "lightning-rod (1752) anticipated the French *para-tonnerres* by a good many years, was in France somewhere about this time, and their introduction into the latter country was probably due to his initiative

One other extract may be given for what it is worth Perhaps the two kinds of lightning observed may have some analogy to the A and B discharges noted by Sir Oliver Lodge —

"It has been completely demonstrated, by a great number of observations, that the lightning often rises from the earth If the electricity, the true cause of lightning is in excess in the clouds, the discharge is earthwards If, on the contrary, it is accumulated in the bosom of the earth, it escapes to expand itself into equilibrium in the atmosphere In order that a building may be defended against these two dangers, it is therefore necessary to establish *ascending* lightning-conductors [*des para-tonnerres ascendans*] against the lightning which rises, as they have been established against that which falls It is necessary to have recourse to the ascending lightning-conductors of the Abbe Bertholon He has safeguarded in this way a belfry at Lyons, on which the thunder (*sic*) had very often fallen" (The appropriateness of the example cited is very far from clear)

The extracts are from vol 6, pp 238-242, of the work mentioned H C Browne

Dublin, July 27

Fish Poisons as Insecticides

In many widely separated tropical countries it has been the rather curious custom of the natives to catch fish in lakes, rivers, and creeks by means of certain poisonous plants, the leaves, stems, or roots being used for this purpose The water extract obtained by macerating the appropriate part of the plant is poured into the stream, and the fish being rapidly stupefied by it are readily caught The practice is now generally discouraged, owing to the heavy mortality ensuing amongst the small and immature fish

Extracts obtained from some of these plants have been shown to have an insecticidal action of a high order Among these are different species of Derris and Tephrosia both of which contain non-nitrogenous constituents highly poisonous to fish Recently, Mr R A Altson, of the Botanic Gardens Georgetown, British Guiana, has secured for us two plants employed by the aborigines of that country as fish poisons and known to them as "Black and White Haiari'

Mr Altson refers these plants to the order Leguminosæ and states that the Indians use them in the following manner "The roots of White Haiari and the stems of Black Haiari are beaten out into a 'horse-tail and shaken into water, which afterwards is thrown into the creek In about ten minutes the fish in that area are either stupefied or killed and float to the surface"

Extracts prepared from Black and White Haiari with water and organic solvents have been recently tested in this laboratory as contact insecticides, and both, but particularly those prepared by the use of organic solvents, have been found to be highly poisonous to aphides

It is of interest that all of the above plants belong to the order Leguminosæ, while those of other natural orders which are used as fish poisons have not so far proved in our investigations at Rothamsted to be of much interest from an insecticidal point of view

Various investigators have isolated the poisons from *Derris elliptica* and *Tephrosia vogelii*, but little is known of their constitution although suggestions have been made as to a possible lactone structure No information is available so far as we are aware, about the toxic constituents of Black and White Haiari We have, however, obtained colourless crystalline derivatives from both, which may be of significance in this respect

Black and White Haiari may prove of economic importance as insecticides F Tattersfield

Rothamsted Experimental Station
Harpenden July 15

X-Ray Diffraction Patterns from Plant Fibres

Diffraction patterns obtained from plant fibres ramie hemp, etc, by using a method similar to that of Hull for crystal powders (*Phys Review* 10 2, 661 1917) do not agree in certain particulars with the data reported by Herzog and Jancke in *Zeits fur Physik*, 3-3 196 to 198, 1920 They give a list of eight sets of planes based on data obtained by using the "white light" radiation from a copper anticathode and eliminating by inspection the K_β reflections In our work, molybdenum radiation was used and a monochromatic beam was obtained by filtering through a zirconium oxide screen

As will be seen in the table, several interplanar spacings check satisfactorily, others, however, do not We found that by manipulating the exposure and size of slit, a line which might be accepted as 5 80 under one set of adjustments could be resolved into two lines, 6 10 and 5 40 Similarly, 3 30 and 2 60 lines were resolved as shown in the table Merely for convenience the lines are designated by the figures which express the value of the interplanar spacings Certain orientations of the bundle of fibres were also necessary in order to produce the separation of the lines

Interplanar Spacings in Plant Fibres

Reported by Herzog and Jancke $K_\alpha Cu = 1\ 54$	New Values	Remarks
5 80	6 10 5 40	Resolved
4 02	3 98	
3 30	3 40 3 20	Resolved
2 90		K_β line
2 60	2 62 2 58	Resolved
2 18 2 01 1 10	2 17 2 03 1 11	

The so-called 2 90 line was readily found when the unfiltered beam was used, but when the K_β wave-lengths were screened out, it failed to appear The K_β reflection from the 2 60 planes seemed to have contributed largely if not entirely to that line Among the thirty odd lines which we found with the monochromatic beam there appears a very faint 2 93 but that line is so weak that it does not seem probable that it is the one which Herzog records

Only the few lines needed to make the above corrections are reported here, a more detailed discussion of the patterns and the lattice will appear elsewhere O L Sponsler

University of California, Southern Branch,
Los Angeles, California

A Low Frequency Oscillator

IT may be of interest to readers of NATURE who are working with low frequency to know of a new form of oscillator.

At present I am using a low frequency oscillator which gives excellent results with a delicate adjustment of the frequency to a given value. The circuit used is that in which the oscillations are produced by coupling the grid and plate circuits of a thermionic

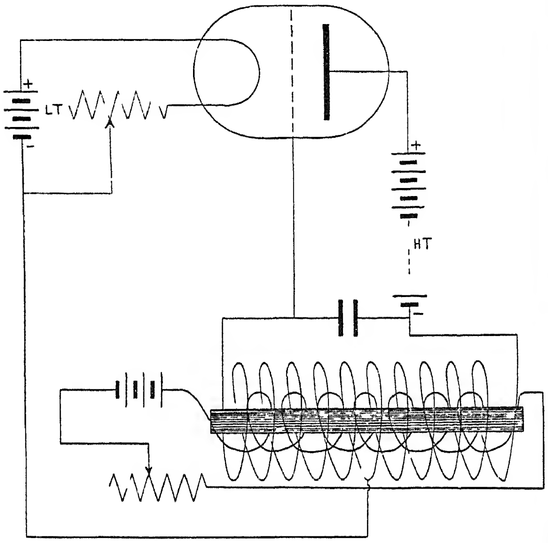


FIG 1

valve by mutual inductance and capacity. In the ordinary circuit the frequency is changed by sliding an iron core. In the circuit now described the inductance is altered by passing a D C current round an iron core. The pitch of the note for a given capacity changes as the exciting current changes. There are many advantages of this oscillator, one of which is the maintenance of symmetry for the different inductances. A full description with test details is now in course of preparation for publication. The diagram (Fig 1) gives an idea of the oscillator circuit and how it works.

C CONSTANÇON

University of the Witwatersrand,
Milner Park, Johannesburg
July 1

Doublet Separation in C II and Si IV

FURTHER work has been done on the ultraviolet spectrum of carbon and silicon using a diffraction grating having a radius of 192 1 cm. The resultant dispersion of about 9 Å U per mm has enabled us to obtain the following spectral lines in Fowler's [1] series for C^+ as doublets and to measure the separation as shown in the following table

Line Bohr's Notation	$\Delta\nu$ observed 2nd order	$\Delta\nu$ observed 3rd order	$\Delta\nu$ as calculated by Fowler [1]
$\left.\begin{matrix}2\pi_1-3\sigma\\ 2\pi-3\sigma\end{matrix}\right\}\lambda=858$ Å U	64	60	58
$\left.\begin{matrix}2\pi_1-3\delta\\ 2\pi_2-3\delta\end{matrix}\right\}\lambda=687$ Å U	64 5		58

The separation of the components of the line at 858 Å U was measured in the second order on nine plates and in the third order on three plates, using a comparator reading to 0 001 mm and taking the average obtained from ten settings on each component. The measurements on 687 Å U were made in the second order only and on two plates.

The third member of the first sharp series was not recorded by Fowler, but was found by one of us [2] as an unresolved line at 577 4 Å U.

We have also measured the separation of the doublets at 1335 and 1036 Å U, and the results from seven different plates, using the second order, give $\Delta\nu=65$ for the 1335 doublet and $\Delta\nu=62$ for 1036. The focussing in the case of the latter was not so sharp as for 1335, but the results seem to indicate that the two separations are the same and that 1335 therefore belongs to C^+ as Millikan [3] has already stated.

In the series of Si IV as recorded by Fowler,[4] we have resolved the doublet $3\sigma_1-4\pi$, $3\sigma_2-4\pi$ in the second order and find the separation $\Delta\nu=153$.

The following lines in these series not previously recorded have also been found: $4\sigma-6\pi$ in first order only and unresolved, and the single line $4\delta-7\phi$.

Experimental details will shortly be published.

R J LANG
STANLEY SMITH

Department of Physics, University of Alberta,
Edmonton, Alberta, Canada, July 11

The Attraction between Homologous Chromosomes

IT has been shown that the chromosomes of Datura (*American Naturalist*, vol 56, pp 339–346, 1922), Hyacinthus (*Genetics* vol 10, pp 59–71 1925) and Uvularia (*Journal of Genetics*, in press), for example, are combined side by side, and end to end, at the reduction division. If n is the haploid number of chromosomes, this finding of partners and conjugation of chromosomes points to the presence of $2n$ different attractions. (It is easily demonstrated in Uvularia that homologous ends of each chromosome are opposed, for the ends of the chromosomes differ in appearance.) This is confirmed by the formation of trivalents, quadrivalents, quinquevalents, etc, in triploid, tetraploid,

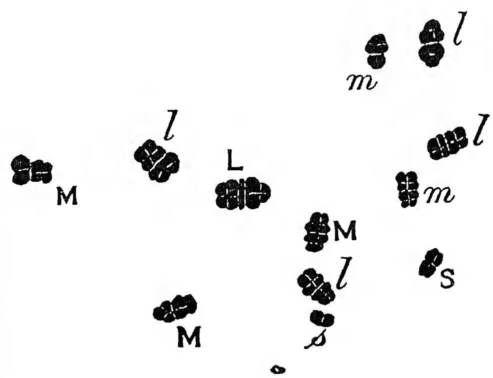


FIG 1 —Datura chromosomes

and other plants with more than two homologous chromosomes, and also by the fact that none of the 12 chromosomes of the haploid Datura pair at the reduction division (Fig 1). Such a number of attracting forces seems perhaps unexampled in physics.

JOHN BELLING

Carnegie Institution of Washington

[1] Proc Roy Soc, March 1924

[2] Trans Roy Soc, A, 224, 371 419

[3] *Phy Rev*, September 1924

[4] Proc Roy Soc, June 1923

Science in South Africa [1]

By General the Right Hon JAN CHRISTIAAN SMUTS, P C

THE Wegener hypothesis purports to explain the origin, the past and the present of all the continents and oceans of this globe But for us in South Africa it has a special interest in its account of the origin and distribution of continents in the southern hemisphere Whether this account is correct or not, the hypothesis has the great merit of focussing attention on many great problems which call for explanation, and it has the further merit of associating these problems and making them parts and aspects of a great common scheme, instead of merely leaving them, as disjointed unconnected items, scattered haphazard over the various special sciences

For us in this part of the world, the most interesting feature of the scheme is that in it Africa assumes a central position among the continents, it becomes, in fact the great "divide" among the continents of the southern hemisphere, it appears as the mother-continent from which South America on one side, and Madagascar, India, Australasia and their surrounding areas on the other, have split off and drifted away, have calved off, so to speak The evidence for all this is strong, but it may well be that the evidence is yet insufficient to account for the whole Wegener hypothesis It may not be strong enough to prove the actual disruption and separation of the continents in the past which is the essence of the hypothesis But even so it may be right in assigning to the African continent a central determining position in respect of many of the great unsolved problems of geographical distribution, and in making that position the key which science will have to use in ever-increasing measure if it wishes to unlock the door to future advances The value of a hypothesis often depends not so much on its correctness as on its fruitfulness For the present I am prepared to look upon Wegener's hypothesis as a fruitful point of view more than a solution, as a suggestive line of thought and research along which useful work may be done in the future

One important line of research which it suggests to us is the east/west aspect in addition to the hitherto prevalent north/south line of orientation Hitherto it is the European affiliations which have guided our thought and our research, we have looked to the north for explanations as well as our origins In future, on the lines of Wegener's speculations, we shall look more to east and west—to our affiliations with South America, India, and Madagascar and Australasia, for the great connexions which can explain the problems of our past and present We shall look upon southern Africa as the centre of the southern hemisphere and correlate all the relevant scientific problems of this hemisphere from that new point of view This new aspect will establish new contacts, and it is generally such new contacts which prove fruitful and creative for scientific progress

Let me first take the case of geology, a science in which a very high standard of success and excellence has been achieved in South Africa A great amount of attention has been devoted to the question of the correlation of our geological formations with those of Europe, and although many unsolved problems still remain, the main outlines of the correspondence of our formations with those of the northern hemisphere have been successfully worked out A good deal has been done, yet quite insufficient to correlate our formations with those of South America, India or Australasia Yet it is evident that the subject is one of profound interest, both from a scientific and a practical point of view Several of our formations at the Cape seem to be continued or paralleled by identical or similar formations in India and South America A proper correlation of the geological systems may lead to most interesting results, and may also throw great light on the past of the three continents We may thereby be enabled to explain just why they are practically the sole producers of the world's diamonds, why the diamond-fields of South-West Africa are situated on one edge of the Atlantic and those of Brazil on the other, why the coal-fields of these three countries and of Australia are confined to the eastern halves of each of these land masses, and why the curious and ancient banded-ironstones are so widely spread in South Africa, Brazil, peninsular India and Western Australia, though absent from Europe The results of such a comparative study for the southern hemisphere might be most valuable and might settle many of the problems which still agitate science as to the past of the earth

It is when we come to the biological sciences, however, that such a comparative study promises the most fruitful results Here there is a number of momentous problems still awaiting solution Consider, for example, the problems affecting our botany We have two distinct floras in South Africa, one, the South African flora which covers most of sub-tropical Africa and is clearly of tropical origin, the other, a temperate flora, found only in the south-west of the Cape Province on the seaward side of the first great mountain barrier, with outliers extending to the north along the mountain systems into the tropics The two floras are apparently quite different and distinct and are engaged in a mortal conflict with each other, in which the temperate or Cape flora is slowly losing ground This Cape flora forms indeed a problem of profound and baffling interest What is its origin, and what its relation to the South African flora? The South African flora is, as I have said, clearly of tropical origin, and consists largely of subtropical derivations and modifications of the tropical forms found farther north in the equatorial regions Can its origin be traced further back? In the answer to this question we meet again with what I may call the European fallacy, or the fallacy of the European origin The current idea among botanists is that northern Europe is the source and the north temperate flora of Europe is the origin of both our South African and Cape floras The north temperate flora of Europe is supposed to have been driven south by the onset of the last great Ice Age in Europe and, in the much cooler climate of the tropics at that time, to have migrated southward along the eastern mountain systems of Africa until southern Africa was reached

[1] From the presidential address to the South African Association for the Advancement of Science, delivered at Oudtshoorn Cape Province, on July 6

This common view of the European origin of our floras will, however, require very careful reconsideration from the viewpoint which I am suggesting here The correlation of our floras with the other floras of the southern hemisphere may profoundly affect this question of origins, and may throw much fresh light not only on the origin of our floras in Southern Africa, but even on so momentous a question as the origin of the flowering plants and on geographical distribution generally Even according to our present knowledge, the African floras do not seem to fit in well with the current view of their origin Apart from the Cape flora in the extreme south, and the Mediterranean temperate flora in the extreme north, the African flora—better known as the Tropical African flora or the Palæotropical African flora—covers the rest of the continent In this flora an element predominates which is peculiar to this part of the world, but is more or less closely related to the floras of India, Madagascar, Australasia and South America In other words, the special affiliations of the Tropical African flora are in the southern hemisphere Similarly the Cape flora has peculiar affiliations with the floras of certain countries in the southern hemisphere The current view of the northern origin may therefore not be the last word so far as botany is concerned

On this question we have the following two interesting facts First, the fact already mentioned that the chief types of the African flora have their affiliations in the southern and not in the northern hemisphere Secondly, the fact that the chief types of the present Cape flora, such as the Proteaceæ, Rutaceæ, and Restiaceæ, to-day occupy the areas that correspond to the former Gondwanaland, that is to say, exactly the same area which was covered by the Glossopteris flora in Mesozoic times It is alleged that some fossil types of Proteaceæ have been found in Central Europe in lower Cretaceous deposits, but these finds are disputed These two facts would seem to point to the conclusion that the two African floras are probably of southern origin and have not been derived from the northern or European flora Nay, more, the suggestion of Seward that the Mesozoic flora of Europe, which is markedly dissimilar from that of its Palæozoic flora, may have had a southern origin in Gondwanaland, opens up very interesting possibilities Indeed, in the palæobotany of the southern hemisphere we are only at the beginnings, and who knows whether further discoveries in this largely virgin field of research may not yet give point and substance to Darwin's surmise that the existence far back in the long ages of an extremely isolated Southern Continent is somehow to be linked with the mysterious origin of flowering plants

Some of the greatest problems of botany, of geographical distribution, and of the past of the earth will have to wait for their solution until palæobotany has made much further advances in South Africa and the southern hemisphere generally In this connexion a great opportunity lies before science in South Africa I trust a step will be taken by the establishment of a chair of palæobotany at one or other of our South African universities It will be a small step, but its significance will be great and its results may be far-reaching

So far I have only referred to the evidence of palæobotany But the evidence of our southern palæontology generally is all in the same direction Still more so is the evidence of the present botanical distribution throughout the southern hemisphere The present distribution is not only strong presumptive evidence in favour either of a great Southern Continent or great land connexions in the south in the past, but also in favour of the independent origin of the African flora Dr Otto Stapf, whose knowledge of African grasses is unrivalled, goes even further in his masterly "Grasenflora Sud-Afrikas," and would seem to suggest that very special importance is to be attached to the unique character of the Cape flora as distinguished from the African flora The Cape flora points not only to a southern origin but to an origin even farther south than the ancient Gondwanaland is commonly supposed to have extended May we not venture the suggestion that the Cape temperate flora is the survival of an Antarctic and sub-Antarctic flora which has perished in the climatic changes of the past? That, at any rate, would account for its marked differences from our subtropical South African flora

Enough has been said to show how important it is that there should be a regular comparative study of the scientific problems of the countries which lie in the southern hemisphere, with South Africa as the centre of the whole group Such a comparative study promises rich results and will probably give a new direction and a fresh impetus to many branches of scientific work For this purpose it seems to me not only advisable to devote more attention to palæobotany at our universities, but also essential that South African students and workers should visit other countries of our hemisphere and familiarise themselves with the scientific conditions and problems which obtain there

Let us now pass on from biological questions to the problems of South African climate and meteorology, which I need scarcely point out are of supreme importance not only in an economic but also in a scientific sense Here, too, we shall find that the present has its roots deep in the far-off past

Great ice-ages are known to have occurred far back at the beginnings of geological time before the present sedimentary formations were laid down To pass to the other extreme, Europe during the Permo-Carboniferous period, when the coal measures were mostly laid down, possessed the climate of a sub-tropical rain-forest, and at a much later date the magnolia and similar tropical plants flourished in Greenland and Spitsbergen At that time, Europe was mostly covered by shallow seas and its tropical climate was balanced by a cold dry climate which existed in the contemporaneous Gondwanaland of the southern hemisphere The Glossopteris flora of the latter was the vegetation of a cold dry climate, and the glaciation of many parts of Gondwanaland, of which evidence is visible over a large part of South Africa, shows that great ice-masses must have covered its high table-land Much other evidence points to the fact that the ancient Africa which formed the centre of Gondwanaland was on the whole a cold and arid country

Gondwanaland must have been an unpleasant country to live in, not only because of its climate but also because of the vast geological disturbances which were gradually tearing it to pieces Even if the tearing

asunder and drifting apart of the ancient continent according to Wegener did not take place, there must have been submergence and disappearance under the sea of great land connexions between the countries of the southern hemisphere. Other indisputable evidence of the severe and long-continued convulsions of Africa during the Tertiary times exists. The vast cracks and fissures which rent it from south to north exist to-day still in the chains of great lakes and "rift-valleys," which extend across Africa from the Zambezi to the Red Sea, the Dead Sea and the deep valley of the Jordan. Farther north the crust of the earth folded up slowly like a crumpled scroll, and as a result the huge mountain chains of the Atlas and the Alps, the Taurus and the Himalayas were formed. Volcanoes burst forth in Africa in many places along the lines of weakness, while in the south the diamond pipes were formed. During this prolonged period of change the climate of southern Africa also must have changed considerably, for instead of the cold of Mesozoic Gondwanaland, we find so far south as Kerguelen Island the remains of araucarias which must have flourished there in Tertiary times.

These far-off climatic conditions of the ancient Africa have for us of to-day only a mild scientific interest. But the remarkable changes in terrestrial climate which set in at the end of the Tertiary period are on a different footing and have produced effects which are still felt by us in the present era. A marked elevation took place in the lands of the southern hemisphere, and South Africa ended considerably farther south and nearer to the Antarctic than to-day. Then the snow began to fall and the ice to form on Scandinavia, and the glaciers and ice-fields to extend south into Central Europe. Similar conditions ensued in North America and Antarctica. The last Great Ice-Age had begun, with effects which were felt right across the equator into subtropical southern Africa. The increasing cold in the Antarctic and the subantarctic islands wiped out the entire south temperate flora with the single considerable exception of its most northern outlier in the South-West Cape, where it still survives as a unique relic of the past. The combined effects of the two northern and southern cold areas were reflected in moister conditions and greater rainfall in southern Africa during the Pleistocene than we have to-day.

Throughout the half a million to a million years which cover this period, the land level of northern Europe kept oscillating, and the Scandinavian ice-mantle was growing or dwindling, with mild or even warm interglacial periods between. It was in the last two interglacial phases that man appeared in Europe, not yet *Homo sapiens*, but earlier species of mankind. To locate ourselves properly in the frame of the geological picture we have to envisage ourselves as living in a new and mild interglacial period; we have to remember that Scandinavia is once more rising at the present rate of perhaps a metre or more per century, and that in another ten thousand years or more Europe will possibly be once more in the grip of a great ice-age. South Africa is also rising at a rate which has not yet been determined but is appreciable, our climate will gradually become cooler, until we shall again have more moist and rainy conditions than to-day; and the voices of the Schwarzes will no longer be heard crying in the wilderness which will have passed away. We may regret that we shall not live to see that day, but that regret will be tempered by the further thought that hitherto each interglacial phase has seen the passing away of a lower species of the human genus to make way for a higher one, and that in all probability our present human races will before the next phase have had to disappear and make way for the higher species of humans which it is hoped will occupy the next age.

The factors which affect large divisions and periodicities of climate and rainfall are still a matter of controversy amongst scientists. But there can be little doubt that the formation of the great Scandinavian ice field, partly at any rate through land elevation at the end of the Pliocene, had the most profound effect on the climate and the history of Europe and Asia during the present geological period. A great anti-cyclonic storm centre was thereupon established, which displaced the rain-bearing cyclonic belts and thereby produced the most far-reaching changes, which were felt even across the equator of the old world.

The Great Ice-Age in Europe appears to have synchronised with a period of greater rainfall in Africa, including South Africa. The remains of great rivers and lakes in all parts of southern Africa, and the gravel terraces in certain regions which are now waterless deserts, bear witness to the higher rainfall during the Pleistocene and to the consequent accumulation of surplus waters in the sub-continent. The Swedish geologist de Geer has by methods of remarkable ingenuity and accuracy determined that the ice-body finally retreated from Sweden about twelve thousand years ago, and this result agrees very well with the corresponding estimates obtained in North America. We may therefore take it that during the last ten thousand or twelve thousand years South Africa has been experiencing a lessening rainfall; the run-off of the rivers to the ocean has not been properly compensated for by rain. There has thus been a progressive desiccation of the land, and the arid or semi-desert conditions of to-day have probably been in existence for some thousands of years. That is the opinion of Passarge ("Die Kalahari," c. 37), who made a closer study of this question in the Kalahari region than any other worker. At the same time it has to be admitted that we are still ignorant of or in doubt about a number of matters bearing on the past rainfall of southern Africa, and important problems still await the attention of our scientific workers in this regard. Prof. Schwarz's writings have focussed much popular attention on some of these questions, but in scientific circles the matter as a whole has not yet received the attention it deserves. It is to be hoped that this omission will soon be repaired, for there can be no question either of the scientific interest or the practical economic importance of the subject as a whole.

Meteorology ought to occupy a foremost place in our activities as a State and as a country for scientific investigation. The comparative smallness and seasonal uncertainties of our rainfall make this a matter of the greatest economic importance, while our central position in the southern hemisphere carries with it peculiar advantages and responsibilities for meteorological observation and research. Yet very little pure research has so far been done. In his letter to the recent

Drought Investigation Commission Dr G C Simpson, Director of the Meteorological Office, London, makes the following grave charge against us

> Of the large land surfaces the meteorological conditions of Africa are probably the least known for except from Egypt we receive practically no meteorological information from this great continent and South Africa is probably the largest area having a settled civilised Government which publishes little or no meteorological information officially

and he goes on to make the following recommendation

> The most hopeful method of attack on the problem of seasonal forecasts is to compare and correlate the records of various meteorological factors thus one of the first steps to the attainment of your object will be the formation of a strong meteorological service to gather data of satisfactory reliability from Africa itself, and probably, in connection with other countries in the Southern hemisphere from the Antarctic continent I do not think that one country alone should undertake to place meteorological observatories on the Antarctic continent There should be international co-operation of the countries interested, and the aim should be to establish one or more observatories which can be kept in constant activity along a well-planned programme for an indefinite time

Here, then, is a very valuable suggestion for us to act on The Argentine Government has already made a start by maintaining two meteorological stations in the Antarctic, one on the South Orkneys and one in South Georgia If the Union of South Africa and Australia could agree each to maintain an Antarctic station opposite or to the south-west of their respective territories, and the work of the four Antarctic stations could be co-ordinated, the results might be of the utmost value

The discussion of our climate and meteorology leads me to mention the subject of astronomy and to refer for a moment to some of the outstanding contributions which have been made to it in South Africa Here, too, our favourable situation in the southern hemisphere and our meteorological conditions, unrivalled for astronomical research, have enabled South Africa to play an honourable part in the advancement of science Here it was that in the middle of the eighteenth century the Abbe Lacaille made the first scientific catalogue of Southern Stars Here, too, it was that early in the nineteenth century our second Astronomer-Royal, Henderson, made the first determination of the distance of a fixed star from the earth, in the case of α-Centauri Here it was that Sir David Gill made the classic determination of the mean distance of the sun from the earth, a determination the accuracy of which has received only additional confirmation from subsequent determinations

The Cape is also the birthplace of many other lines of astronomical research It was at the Cape Observatory that celestial photography had its real beginning Previous to 1882 it was more an amusement in, than an auxiliary to, astronomy But in that year Gill, while photographing the great comet, was struck with the power of the photographic plate to picture the faintest stars Forthwith he conceived the idea of photographing the whole heavens, and thus the most efficient and far-reaching arm in stellar research had its beginnings From that day photography became the most powerful weapon in the astronomical armoury The epoch-making departure thus happily initiated will now be further followed up in South Africa with the great resources of the United States of America We wish the Yale Observatory at Johannesburg under Dr Schlesinger, and the coming Princeton Observatory at Bloemfontein under Dr Hussey, all possible success in the important tasks they have set themselves

Let me mention a second line of astronomical research where South Africa was responsible for taking the initiative For many years it was the home of variable star research The first observatory in the southern hemisphere for this special branch of astronomy was built at Lovedale in 1891 by Senator A W Roberts It was at this observatory that he made the first estimates of stellar densities, as well as the earliest determinations of close binary systems and their evolution This pioneer work has led to most important developments in astronomy which are now rapidly revolutionising our views as to the origin and evolution of the material universe On all these grounds the record of South Africa in astronomical research is indeed one of outstanding distinction, and there is no reason why this record should not be maintained for the future in this land of clear skies, of equitable climate, of peaceful days and cloudless nights, where an endless attraction and a rich promise are continually held out to the lover of the heavens

I now pass on to the last science which I shall refer to as one to which South Africa should, from its central position, be able to make a great contribution in the future I refer to human palæontology Three finds of outstanding importance have in recent years signalled South Africa as a great field of research into the human past The first was the discovery of the Boskop skull, which traced the Strandlooper and Hottentot peoples of South Africa to their prehistoric ancestry The second was the discovery of *Homo rhodesiensis* at Broken Hill, which Prof Elliot Smith is reported to have declared one of the most significant finds ever made in human palæontology because by that discovery Africa for the first time realised our firm expectation of providing extinct types of the human family that present problems of exceptional interest Finally, we have *Australopithecus africanus*, which largely breaks new ground in palæontology

In *Australopithecus africanus* we have a transitional form between the ape and the human, we have a creature which is still indisputably an ape, but with certain facial features and a brain development which take it some way towards the human Looking upon the human and the ape forms as the two extremes which will have to be bridged by palæontology, we note that this can be effected in either of the two ways We may find fossil forms carrying the human further back into its human or prehuman past, or we may find fossil forms carrying the ape form forward towards some intermediate point on the road towards the human The Broken Hill skull has done the first, and the Taungs skull has done the second Together they form an outstanding contribution to the elucidation of a most difficult but most fascinating problem of anthropological science

It is a remarkable fact that *Homo rhodesiensis*, although apparently a more primitive and simian type than *Homo neanderthalensis*, was found still unfossilised, and among animal remains which belong to still living Rhodesian species The deduction has been made that *Homo rhodesiensis* was living quite out of his proper geological horizon, and was surviving in South Africa long ages after his compeers in Europe had passed away In fact he was probably still flourishing in the south when his European " contemporaries " had been dead for thousands of years But there is really nothing singular in such an idea After all, such a situation is typical of South Africa in more respects than one Our Bushmen are nothing but living fossils whose " contemporaries " disappeared from Europe many thousands of years ago The interest of South Africa as a field for anthropological research is partly just this, that it is possibly ten thousand years behind the times, as measured by the standards of European cultures In this respect our anthropology does not stand alone, for in botany also we have true " living fossils " like the cycads In South Africa, therefore, certain biological problems can still be studied from life which in Europe can only be deduced with difficulty from the fossil records of the past

That is by no means, however, the only or the best claim that South Africa can put forward as a fitting place for palæontological study and research Discoveries already made point to the possibility that South Africa may yet figure as the cradle of mankind, or shall I rather say one of the cradles? As we have seen, it is not only one of the oldest land surfaces but also, since the end of the Mesozoic period, it has generally enjoyed a fairly habitable though, on the whole, dry climate While in Tertiary and Pleistocene times most of Europe and much of Asia and North America were intermittently under ice or shallow seas, southern Africa was very much as it is to-day No wonder, therefore, that it should contain some of the most ancient fossil records of the human race, and that among its living races it should include what are " fossils " in other continents Its little Bushmen are unique, its little pigmy population that hide in the tropical and subtropical parts are the representatives of the long-vanished human past Going a little further back, we find in Africa the home of the great anthropoid apes which are nearest to us in the affinities of life Here then we are clearly near to the great origins These and other considerations point to the vast importance of Africa from a palæontological point of view, if not to the possibility that here may yet be found some intimate connexion with the far-off beginnings of the human race The scope for scientific work in South Africa in this department of knowledge is therefore immense

Science has in South Africa a splendid field of labour other nations may well envy us the rich ores of this great " scientific divide " which is our heritage I trust that South African science will rise to the height of its great opportunities, and that this sub-continent will yet earn for itself that scientific leadership of the southern hemisphere to which its central position and its great scientific assets and opportunities entitle it

The Crystalline Structure of Inorganic Salts [1]

By Prof W L Bragg, F R S, Langworthy Professor of Physics, University of Manchester

The examination of crystalline bodies by means of X-rays has enabled us to discover the positions of the atoms in the crystal In the earlier period of X-ray analysis it was only possible to do this when the atoms were arranged according to a simple pattern of high symmetry Experience has increased the range of substances to which the new methods can be applied, and we can now assign structures to relatively complex crystals, basing the proposed structure on the manner in which the crystal diffracts the radiation

The study of the crystalline structure of organic and inorganic compounds has revealed certain broad distinctions between these two classes of crystals The crystalline arrangement throws new light on those differences in the structure of the molecule which have made it convenient to distinguish organic from inorganic chemistry No exact line can be drawn between the two classes of crystals, and yet the main features are sufficiently different to make the classification useful The organic crystal appears to be composed of definite molecules Inside each molecule the atoms are bound together by forces so local, and so rigid, that an addition to one part of the molecule scarcely affects the rest, these molecules are then massed together by comparatively weak forces into a crystalline structure The form of the inorganic crystal suggests that the bonds between atom and atom are not limited to certain directions, the molecule is more fluid, and an addition to one part profoundly disturbs the relationship of all the rest It must be this molecular fluidity which makes it so hard to apply the ideas of stereochemistry to inorganic compounds although they have been so successful in explaining the organic compounds

Our powers of X-ray analysis are as yet very incomplete and it is difficult to find the positions of the atoms in complex structures The complexity of a structure depends on the number of parameters, or degrees of freedom permitted by the symmetry, which fix the positions of the atoms in its pattern At the present time any structure with more than half-a-dozen of these independent parameters presents a difficult problem Crystals with two or three parameters are comparatively simple For several reasons the inorganic salts can be analysed more completely than organic compounds In the first place, the number of atoms in the inorganic molecule is generally smaller than that in the organic molecule, and owing to the power of readjustment in the former class of compound which has already been mentioned, the atoms often take up a symmetrical arrangement and this symmetry makes the X-ray investigation more easy Every requirement of symmetry which must be satisfied by the atom reduces the number of variable

[1] Discourse delivered at the Royal Institution on Friday, May 1

parameters in the structure, and confines the atom to certain planes, lines, or points from which it cannot move. Further, in a series of inorganic crystals it is often possible to replace one atom by another of similar chemical properties without altering the crystalline structure. Now the heavier atoms scatter X-rays more than the lighter atoms. If, therefore, we wish to find the position of the metal atoms in an inorganic salt, and a crystal of the series is available in which the metal has a high atomic weight compared with the other constituents, it is an easy matter to fix its position. The same process can often be carried out with a heavy atom in the acid radical and a light one in place of the metal. In order to aid the X-ray examination we are using a method which is precisely like the staining, by means of suitable dyes, of certain parts of a microscopic preparation. In the organic crystal the atoms of carbon, oxygen, and nitrogen are almost indistinguishable by means of X-rays since they are so close in the periodic table, and, with the exception of one or two compounds, it has so far been impossible to fix their positions.

The inorganic salts are interesting not only because we know more about their structure, but also because they lend themselves more readily to mathematical treatment. We may compare this case of crystal equilibrium to the engineering problem of calculating the stresses to which the members of a girder system are subjected. If the number of constraints is the minimum requisite for rigidity, these stresses can be directly calculated by simple laws of mechanics. If the whole structure is too rigid, much more detail must be known about the structure in order to calculate the stresses. The inorganic crystal represents the structure with the minimum number of constraints. We can try to explain the properties of the crystal as a whole by making certain simple assumptions about the forces between the atoms. It is certain that the real atomic properties are more complex than those represented by these simple assumptions, but it is interesting to see how far one can get towards an explanation with their aid. For example, a number of crystalline properties can be explained by assuming an atomic model of the following kind:

(*a*) The atom consists of a symmetrical electronic structure surrounding the nucleus in which the charges on the electrons and on the nucleus do not balance, so that the sum of the charges is sometimes positive, sometimes negative.

(*b*) When the atoms approach within a certain distance of each other a force of repulsion between their outer electronic structures sets in very rapidly and prevents closer approach.

(*c*) When the atom is placed in an electric field it becomes polarised. Its positive and negative parts are drawn in opposite directions and it is surrounded by a field like that of an electrical doublet.

With the aid of these assumptions, qualitative explanations have been given of the formation of inorganic compounds (Kossel) and quantitative explanations of the heats of formation, heats of solution, latent heats of evaporation, and elastic properties of the inorganic crystals (Born and Lande, Madelung, Fajans, and others). Their highly interesting investigations have been applied to crystals of a symmetrical and simple type, such as the rock-salt structure. The quantitative agreement between calculated and observed data is most striking and shows that the assumptions which have been made are not far from the truth. I do not wish to discuss their results here; I quote them to show how far this atomic model explains the facts, as I wish to use it in examining the more complex salts which we have analysed by X-rays.

The force which causes two atoms to repel each other when they approach closely is very interesting. We do not know its origin, but it is clear that it sets in very sharply and increases rapidly as the centres of the atoms get closer together. This is so much the case that each atom in the crystalline structure appears to be surrounded by a domain which it occupies to the exclusion of other atoms. We cannot define the size of this domain exactly because the distance of closest approach of two atoms will always depend on the strength of the force driving them together, but the domain varies within narrow limits for the range of forces ordinarily present in a crystal. A knowledge of the domain associated with the atoms and molecular groups is most important in crystal analysis since it limits the possible configurations and confines the atoms to certain regions where they do not overlap too greatly. In a Friday evening discourse at the Royal Institution four years ago, I gave some empirical figures for the radii of these atomic domains and tried to show how these figures could be used to aid crystal analysis. I wish to take this opportunity of saying that I have considerably altered my views on this question; other workers who have dealt with the subject have given alternative estimates of the domains, which I believe to represent the physical facts far better than did my original figures, and in addition a more complete knowledge of crystal structures has shown how elastic the atomic domain is and what care is necessary in using the conception to help analysis. Nevertheless, its very great importance must not be lost sight of, for it is one of the principal aids we have in tackling a difficult crystal structure.

We do not know the exact dimensions of the electronic orbits, but such estimates as can be formed suggest that in a crystal such as rock-salt there are large spaces between the outermost orbits of neighbouring atoms. Each atom has its system of orbits quite distinct and widely separated from those of its neighbours. This is generally true where the charged atoms are of a symmetrical type and held together by electrostatic attraction. On the other hand, where the chemical evidence points to a linkage of the homopolar type, crystal analysis shows the atoms close together as if the electronic orbits were actually linked up.

A series of atomic structures such as O^{--}, F^{-}, Ne, Na^{+}, Mg^{++}, Al^{+++} are supposed by Kossel to have a common configuration resembling that of neon itself. The charges on the atoms are due to the addition or removal of electrons required to give them the correct number for a neon structure. The scale on which the atoms are built must diminish from oxygen to aluminium, owing to the increasing nuclear charge, Al^{+++} being on about one-half the scale of O^{--}. The idea of an atomic domain can only be a very rough approximation to the truth, for in actual fact there must be a different law of force for

every given pair of atoms, in this approximate sense, interatomic distances in simple crystalline structures are in agreement with the supposition that they obey an additive law and that the dimensions of the domain are proportional to those of the atomic structures in a series such as has been given above I directed attention to this additive law as an empirical fact in the discourse referred to above, but made the domain of the positive ions too large and those of the negative ions too small A better interpretation of the significance of the law was given by Wasastjerna in a paper on the "Radii of Ions" in which due weight was given to the relative dimensions of the electronic structures Recently, Jones, in a series of highly interesting papers, has linked up the fields which give the repulsion between atoms of an inert gas, and the fields of the corresponding ionic structures in crystals

Again, in the case of the very simple crystals, good quantitative agreement between calculation and observation of crystal dimensions can be obtained by certain simple assumptions about the nature of the repulsive field due to their electronic structures In the more complex crystals the concept of an atomic domain is by itself sufficient to explain the general configuration of the crystal Cases which are especially interesting are those where the domain of one ion is much larger than that of the other The structure of aluminium oxide, Al_2O_3, is an example Since the oxygen ion is so much larger than the aluminium ion, the structure is that of a series of oxygens in a close-packed arrangement (hexagonal) with aluminium atoms in the interstices acting as a cement to bind the whole together In spinel, $MgAl_2O_4$, the oxygen atoms are in a cubic close-packed arrangement In cadmium iodide, CdI_2, the large iodine atoms are in hexagonal close-packing with cadmium atoms lying between alternate layers perpendicular to the hexagonal axis Tin tetraiodide is another case where a quite complex structure approximates closely to a cubic close-packed arrangement of iodine atoms Such crystals give a great deal of information about the forces between atom and atom

In a few cases it has been possible to determine the shape of the acid radical In CO_3^{--} and NO_3^{-} the oxygen atoms are arranged at the corners of an equilateral triangle around the central atom, and the arrangement must be very nearly the same in ClO_3^{-} Though we do not know the arrangement of the oxygen atoms round the sulphur atom in SO_4^{--} with such certainty, they must be nearly at the corners of a regular tetrahedron, and the arrangement also holds in such groups as ClO_4^{-}, MnO_4^{-}, SeO_4^{--} In an ion such as $PtCl_6$ Wyckoff has shown that the six chlorine atoms are arranged at the corners of a regular octahedron around the platinum atom The simple geometrical shape in each case is interesting, and it is difficult to avoid the conclusion that the outer atoms are all related in the same way to the inner one Kossel regards the inner atom as having a large positive charge, and holding the negatively charged outer atom by electrostatic attraction Although the actual bonds may be of a more complex type, it is interesting to see how much this idea explains The dimensions of the group are in accord with the idea that the large oxygen ions are grouped around a relatively small atomic structure with a high positive charge in the centre, and that the size of the group is mainly determined by the repulsive forces between the oxygens Certain optical properties can be explained by the same conception The refractivity of the acid group is got by assigning a value of about 3 3 to the ionic refractivity of each oxygen, and a very small value to the central atom The strong negative double refraction of carbonates and nitrates, where the groups of oxygen atoms lie in parallel planes, is explained quantitatively by the influence on each other of the oxygen atoms arranged in a triangle On the other hand, most sulphates have a very small birefringence This may be explained by the regular tetrahedral arrangement of oxygens around the sulphur, for such a group on account of its symmetry is optically isotropic

The problem of the other type of binding between atoms, in which the electronic structures seem to fuse together so that the atoms approach each other closely and are rigidly connected, has yet to be solved In acid groups such as CO_3^{--} and SO_4^{--} the atoms may retain separate electronic systems, or the other type of binding may have come into play In any case the atoms must be greatly distorted by their unsymmetrical location X-rays can only tell the positions of the atomic centres, the skeleton of the structure, since the interference between waves scattered by the electrons is so complex The centres can be fixed with considerable certainty, however, and cases of undoubted homopolar combination can be examined The interest of the inorganic structures lies principally in the fact that they can be analysed with some degree of completeness, and it is to be hoped that they will tell more about the binding forces They present a fascinating series of problems for solution

Southampton Meeting of the British Association

LOCAL ARRANGEMENTS —II

VISITING members of the British Association are requested to book for Southampton West Station, where men wearing distinctive armlets will be in attendance on the station platforms to render assistance to members on arrival and to afford information The idea of a special train from Waterloo on the Tuesday, the day before the opening of the meeting (as previously announced), has been dropped because the existing means of communication to Southampton, on further examination, were found to be amply sufficient Baggage may be deposited at the Reception Room if desired for conveyance to the address in Southampton where the member will be staying Tickets of membership may be obtained at the Reception Room

The Reception Room is at King Edward VI Grammar School in the Marlands, two minutes' walk from the West Station Here the following facilities will be provided for members ticket and information bureau, where a representative of the Southern Railway will be in attendance, telephones, smoking and writing room, ladies' rest rooms, post office

exchange of communications between members, cloak room, press bureau, bookstall, administrative rooms, etc

The official restaurant for the meeting will be the Coliseum, situated in Portland Terrace, three minutes' walk from the Reception Room Special arrangements have been made with Messrs Price Bros, caterers, for the convenience and advantage of the members Luncheons and teas will be available For the convenience also of members of the sections meeting at the University College, Highfield, the College refectory will be open for lunches and teas

Rest rooms for ladies have been very kindly provided at each of the following houses (1) Y W C A in Portland Terrace, (2) The "Barova Restaurant," at Messrs Tyrrell and Green, Ltd, Above Bar Street near the Junction, (3) Messrs E Mayes and Son, Ltd, 173-178 High Street, below the Bargate, (4) The Central Hall, at the bottom of East Street Accommodation for both ladies and gentlemen will also be available at the Central Hall An excellent and well-illustrated booklet, "Southampton and the New Forest," compiled by Messrs Russell and Co, will be presented to each member Therein on p 5 will be found a street map of Southampton, and likewise on p 75 a full list of places of worship

Badges, which members are particularly requested to wear on all occasions, will be handed them at the Reception Room, and will prove most valuable for identification of membership The Corporation Tramways Committee has generously decided to extend the privilege of free use of the tramcars and omnibuses of the municipality to members during the period of the meeting

The Royal Southampton Yacht Club, the Constitutional Club, and the Portswood Conservative Club have kindly offered honorary membership during the week to all members of the Association, while the Rotary Club of Southampton invites all visiting Rotarians to the luncheon on the Friday in the South-Western Hotel, and the Masonic Lodges of the town have offered to their brethren in freemasonry and their ladies a reception at the Chantry Hall on the Monday, when afternoon tea will be served A civic reception will be given by His Worship the Mayor and the Mayoress of Southampton at the Pavilion, Royal Pier, on Thursday evening at 8 o'clock, and it is hoped that members will make a point of attending this function A reception will be given by Lord and Lady Swaythling at their mansion, Townhill Park, on Sunday, August 30, at 8 P M, when a special omnibus service will be run in connexion with the event Garden parties will be given by Lord and Lady St Cyres at Walhampton near Lymington on Friday, August 28, at 3 P M, and on the same afternoon by Sir John and Lady Power at Newlands Manor near Lymington, New Forest

The Cunard Co has very generously invited the British Association to visit the R M S *Aquitania*, and have tea on board on Friday, August 28, the White Star Line has extended a similar invitation, to the R M S *Majestic*, on Monday, August 31, while Commander C B Fry has thrown open for inspection the Training Ship *Mercury* on the Hamble River on Saturday, August 29, at 3 30 P M

Invitations for parties from the British Association to see over their works have been received from the following firms The International Cold Storage and Ice Co, Ltd, the Docks, Pirelli General Cable Works, Ltd, Auguste Pellerin Ltd ("Le Dansk" Margarine Factory), The Southern Railway Co for the Docks, Messrs Harland and Wolff, shipbuilders, the Docks, The Ordnance Survey Office, The Avenue, Messrs Toogood and Sons, seedsmen

Two organ recitals have been arranged to be given in the New Central Hall (1) a grand organ recital on the Saturday, August 29, at 7 45 P M (admission 6d), when a large number of seats will be specially reserved for members of the Association, (2) a special organ recital on the Sunday afternoon, August 30 (admission free), from 3 to 4 15 P M This performance will be broadcasted by the British Broadcasting Co and all members of the British Association are heartily invited

General excursions have been arranged as follows —

Thursday, August 27 —Messrs Toogood and Sons, Ltd, Seed Warehouse, "Blighmount," Millbrook, at 3 P M, Pirelli, Ltd, Cable and Tyre Works, Western Esplanade, at 2 30 P M

Friday, August 28 —The s s *Aquitania* invitation from the Cunard Co to inspect the vessel and have tea on board, 3 to 5 P M, New Forest trip, including garden party, by Lord and Lady St Cyres, at Walhampton, near Lymington, at 3 P M (on the return journey, Beaulieu Abbey and House will be visited by invitation from Lord and Lady Montagu), New Forest trip, including garden party, by Sir John and Lady Power, at Newlands Manor, Lymington, at 3 P M, Ordnance Survey Office, The Avenue, Southampton, 2 to 4 P M

Saturday, August 29 —Isle of Wight (whole day) by steamer to Cowes then motor via Newport, Sandown, Ventnor, where lunch will be served, Alum Bay, Carisbrooke, where tea will be had, and back to Cowes, Stonehenge (whole day) via Romsey and Salisbury, returning by Winchester, T S *Mercury* on the Hamble River by steamer (leaving at 2 30 P M) down Southampton Water, Winchester leaving at 2 30 P M, half day excursion

Sunday, August 30 —Reception at Townhill Park by Lord and Lady Swaythling at 8 P M

Monday, August 31 —The s s *Majestic* invitation from the White Star Line to inspect the vessel and have tea on board, 3 to 5 P M, Auguste Pellerin, Ltd, "Le Dansk" Margarine Factory, Northam, at 2 30 P M, Southampton Gaslight Co, Ltd, tea at 3 30 P M at the works, Ordnance Survey Office, The Avenue, Southampton, 2 to 4 P M

Tuesday, September 1 —General visit to Southampton Docks at 2 30 P M, Messrs Harland and Wolff's Ship Repairing Works, the Docks, at 2 30 P M, the International Cold Storage Co, Ltd, the Docks, at 3 30 P M, Goughs Ice Co, Ltd, Canute Road, Southampton, at 5 P M, Ordnance Survey Office, The Avenue, Southampton, 2 to 4 P M

The following sectional excursions have been arranged

Thursday, August 27 —K, Hythe and Beaulieu, G, Southampton Docks, K (Forestry Subsection), Messrs Howard Bros Timber Yard, Northam, C, The Ordnance Survey Office, The Avenue, Southampton

Friday, August 28.—L, South Stoneham House, (garden party); E, Portsdown Anticline; G, Southampton Waterworks at Otterbourne; C, Bournemouth.

Saturday, August 29.—C, Isle of Wight (whole day); D, Beaulieu via Southampton Water and the Solent (whole day); K, Mear Valley and Portsdown (whole day); H, Salisbury and Stonehenge (whole day); M, Sparsholt Farm Institute (whole day).

Sunday, August 30.—C, Lulworth Cove (whole day); K, New Forest (whole day); L, Winchester.

Monday, August 31.—D, Hayling Island; E, Northern Part of the New Forest; G, Calshot Aerodromes and the Agive Petrol Works at Fawley; I, Antigas School at Tipnor; K (Forestry Subsection), Durley Saw Mills (Messrs. F. Houghton, Ltd.); B, Holton Heath Cordite Factory.

Tuesday, September 1.—D, New Forest; G, Railway Works at Eastleigh; G, Supermarine Aviation Works, Southampton; G, Avro Works at the Hamble; K, Hurst Castle; M, Fruit Farm, Botley; I, Fruit Farm, Gosport; C, Hordle and Barton.

The evening discourse will be given by Mr. R. V. Southwell on "Aeronautical Problems of the Past and of the Future," at 8 P.M., in the Centre Hall, on Friday, August 28. Citizens' lectures have been arranged as follows:

(1) Major A. G. Church, on Thursday at 7.30 P.M., on "Science and the East African Commission" at the Central Hall; (2) Prof. E. V. Appleton, on Saturday at 8 P.M. at the Avenue Hall, on "The Rôle of the Atmosphere in Wireless Telegraphy"; (3) Capt. P. P. Eckersley, on Monday at 8 P.M. at the Central Hall, on "Some Technical Problems of Broadcasting"; (4) Mr. C. J. P. Cave, on Tuesday at 8 P.M. at the Central Hall, on "The Highway of the Air."

Lectures for Young People at the Central Hall are arranged as under:

(1) Dr. F. A. Dixey, on Saturday at 3 P.M., on "Mimicry in Relation to Geographical Distribution." (2) Mr. W. H. Barker, on Monday at 3 P.M., on "The Development of Southampton in Relation to World Commerce"; (3) Prof. W. J. Dakin, on Tuesday at 3 P.M., on "Whaling in the Southern Ocean."

W. RAE SHERRIFFS.

Current Topics and Events

PROF. J. G. MCKENDRICK, F.R.S., the distinguished emeritus professor of physiology in the University of Glasgow, reached the age of eighty-four years on August 12; Sir William Tilden, F.R.S., eminent as a chemist, celebrates his eighty-third birthday on August 15. The former was born at Aberdeen and educated there at the University. For thirty years he was professor of physiology in the University of Glasgow; he was sometime Fullerian professor of physiology at the Royal Institution and president of Section I (Physiology) of the British Association. At the Oxford meeting, in 1894, of the British Association, he exhibited and demonstrated a working model intended to illustrate the mechanism of the cochlea. With Dewar and Ramsay he conducted researches on the physiological action of the chinoline and pyridine bases. Sir William Tilden, a Londoner, was a science master at Clifton College, 1872–80, leaving to take up the chair of chemistry at Mason College, Birmingham, a post which he held for fourteen years. On leaving Birmingham he became professor of chemistry at the Royal College of Science, London, retiring in 1909. He was awarded the Davy medal of the Royal Society in 1908. In organic chemistry he has made highly important researches on the terpenes, for example, on the hydrocarbons from *Pinus sylvestris*, and on terpin and terpinol. Author of many scientific memoirs, he has also published several well-known chemical manuals.

THE report of the Electricity Commissioners in Great Britain for the year 1924-1925, which has just been published, is of considerable interest. In public supply undertakings the output for the year is 7415 million units, which is an increase of about 16 per cent. on the output of the preceding year. In private plants the output would probably be about half as much. The increased output has been obtained at an appreciably higher efficiency. Last year the average coal rate per unit generated was 2.53 lb. In the two preceding years it was 2.67 and 2.78 lb. respectively. This steady progress is satisfactory but there is plenty of scope for improvement. The new Barton station at Manchester shows the highest efficiency, namely, 1.51 lb. of coal per unit generated, and its thermal efficiency is practically twenty per cent. The coal consumption at the gas producer stations ranges from 1.81 to 3.69 lb. per unit generated, the average being 2.60 lb. per unit. The largest Diesel engine oil-driven station (1940 kilowatts) has a thermal efficiency of 26.6 per cent. For small stations internal combustion engines are the most efficient. Water power only contributes about 0.7 per cent. of the total supply of electricity in Great Britain. Several large plants are now being constructed, but the total possible water power is, unfortunately, small.

THE transmission of photographs by means of telephone circuits has recently been perfected to so great a degree that the picture as received is practically a perfect reproduction of the original and shows no signs of the process of transmission. The principle of the method is well known, namely, two cylinders, one at each end of the circuit, rotating synchronously and moving axially so that a spiral line 0.01 in. wide is made to cover the surface dealt with. The sending cylinder has within it a photo-electric cell; the photograph in the form of a transparency or film is attached to the transparent surface of the cylinder, and a small spot of light falls upon the photograph so that the illumination of the photo-electric cell and the current produced are proportioned by the density of the photograph. The current produced is too feeble for transmission, therefore it is amplified, and then, by means of a vacuum tube modulator, imposed on a high frequency carrier current. At the receiving end the current passes through a narrow flat conductor which covers a small hole and is deflected by the current,

opening the hole more or less according to the strength of the current Light passes through this hole and impinges upon a sensitive film carried on the surface of the rotating cylinder The exposed film is developed as usual Mr Mervyn Thompson states (*British Journal of Photography*, July 24, 439) that a 7 × 5 inch photograph is transmitted in $7\frac{1}{2}$ minutes irrespective of the distance, which may be, for example, from San Francisco to New York which is more than three thousand miles

DR S E SHEPPARD, of the Eastman Kodak Company's Research Laboratory, has succeeded in identifying the constituent of gelatine that enables it to confer the extraordinary sensitiveness on silver bromide in the modern photographic dry plate, and gives an account of his work in the Royal Photographic Society's Journal for August Four emulsions prepared by the same method but with different gelatines were found to be almost identical except in sensitiveness, the fastest being about nine times as fast as the slowest Evidently some gelatines are much more "photographically active" than others Mr R F Punnett found that an extract might be prepared from an "active" gelatine which, when added to a relatively inert gelatine, rendered it active, and the question was to find this active ingredient It was found that the acid deliming liquors used in the preparation of gelatine contained it, and several thousand gallons were treated for its extraction 'Gelatine-X," as Dr Sheppard calls it, was found also in many plant materials, especially in black mustard seeds It was now closely identified with either allyl mustard oil or allyl sulphide Tests of various allyl compounds showed that the sensitising power was not due to the allyl group, though "gelatine-X" was finally proved to be allyl isothiocyanate (allyl mustard oil) or allyl thiourea Active gelatines were found to contain about one part of the organic compound in from 300,000 to 1,000,000 parts of gelatine It is this substance that produces the sensitivity centres, that is, the points where development starts, in the particles of silver bromide, and these sensitivity centres consist of silver sulphide, though allyl sulphide itself was found to be inactive Certain selenium and tellurium compounds are effective sensitisers and give sensitivity centres that consist of silver selenide and telluride Further details of this important discovery are to be published later

IN our issue of March 7 p 346, a note appears which deprecates the too sanguine statements made by politicians about the possible economies that can be effected by erecting very large electric generating stations To illustrate this we quoted with approval several statements made by S S Wyer in a report published by the Smithsonian Institution of Washington, in which a comparison is made between the systems adopted on the Canadian and on the American side of the Niagara Falls We also quoted a statement made by Mr Wyer that the service in Ontario is not taxed, so that the lowering of the cost to the consumer is done at the expense of the tax-payers of the districts in which the property is located Naturally we thought that a statement of this gravity would not be made in a publication of the Smithsonian Institution unless all the facts of the case were known and had been studied We have received a letter from Sir Adam Beck, the Chairman of the Hydro-Electric Power Commission of Canada, dated July 20, in which he states that Mr Wyer's assertion is unfounded He also sends us a pamphlet entitled "Misstatements and Misrepresentations derogatory to the Hydro-Electric Power Commission of Ontario contained in a report published by the Smithsonian Institution entitled 'Niagara Falls its Power Possibilities and Preservation,' under the authorship of Samuel S Wyer examined and refuted by Sir Adam Beck" He states categorically that the Power Commission pays taxes both to municipalities and to the Provincial Government to the extent of hundreds of thousands of dollars annually

THE Soviet authorities issue a Weekly News Bulletin of the U S S R Society of Cultural Relations with Foreign Countries, and a recent issue suggests great activity Active preparations are being made to celebrate the bicentenary of the Russian Academy of Science on September 5-14 in Leningrad and Moscow According to the programme which has been issued, the celebrations will commence on the evening of September 5 with a reception in the rooms of the Academy of Science at Leningrad On September 6 there is to be a meeting in the grand hall of the Academy, followed in the evening by a banquet The morning of September 7 is to be devoted to visits to the scientific institutes of the Academy, while on the following day the observatory at Pulkovo and other institutions around Leningrad will be inspected On September 9 the Soviet Government will receive the delegates After further visits and festivities the delegates will leave on September 10 for Moscow, arriving the next day in time for a reception at the Institute of Physics September 12-13 will be devoted to a meeting at the Conservatoire and to visits to the museums at the Kremlin and to scientific institutes in Moscow The celebrations conclude on September 14 with a luncheon given by the "Maison des Savants" In connexion with the celebrations, the authorities are issuing the unpublished works of Lyapunov on mathematics and physics, the syntaxis of Shakhmatov, and the Osset dictionary of Miller, which should be a very valuable publication It is a matter for regret that there must be scores of other important works and papers, which have been lying in manuscript for years, for want of funds The Bulletin referred to above gives some quite interesting brief outlines of archæological work in various parts of Russia, and states that a number of scientific expeditions are being sent to some of the lesser known parts of the country

WE have received a long letter from Dr C G S Sandberg in reference to the notice of his book, 'Geodynamische Probleme," in NATURE of May 23, p 791 He wishes it made clear that the pressures which, according to his view, produce earth movements, are not and cannot be lateral, but are hydrostatic, as

they are due to vapour tension He remarks that Alpine and other similar folding has, according to his theory, been caused by vapour tension hydrostatic pressure, which, finding relief in the directions of least resistance, convey the impression of having been brought about by lateral tangential pressure Dr Sandberg also remarks that the diagram from Lugeon, which was reproduced in his book, was inserted to demonstrate the inseparable relation between tectonic structure and metamorphism, and the remark in the review that such diagrams, whatever may be the ultimate cause of the pressure, indicate that the actual movements are due to lateral compression, is an argument of the reviewer's, and not of Dr Sandberg Dr Sandberg also points out that he does not deny some contraction in the earth as a whole, but emphatically rejects the so-called contraction theory

THE sixty-second annual meeting of the British Pharmaceutical Conference was held in Glasgow on July 27-30 In his address, entitled "Recent and Coming Developments in British Pharmacy," the chairman, Mr E White, dealt with the present and future problems of pharmacy both on the educational and administrative side He gave some account of the proposals of the Pharmaceutical Society to found a laboratory for the physiological testing of drugs, and emphasised the need for such a laboratory He also referred to the results achieved in the recent deliberations of the International Federation at Lausanne In speaking of proprietary medicines, Mr White said that this had been discussed at the Lausanne Conference, and gave it as his opinion that legislation on this subject would not be long delayed, he considered that the Pharmaceutical Society must take an active part in the initiation of such legislation Mr White then spoke of the meeting of the International Conference to be held in Brussels in September, when the standardisation of potent drugs will be considered, and referred to the great advantage to be gained by an international agreement on certain cardinal points in the practice of pharmacy Mr White said he believed that a serious effort to unify pharmacy in the English-speaking communities would yield encouraging results In the Science Section of the Conference, nineteen papers were communicated Among these were papers on the picrates of the opium alkaloids, on the identification of alkaloids and of drugs containing tannins, on the chemical examination of the oleo-resin of Indian valerian root, and on West Australian sandal-wood oil

AT a recent meeting of persons interested in the Peking Union Medical College, which is financed by the China Medical Board of the Rockefeller Foundation, an organisation called the Yu Wang Fu Association was formed It was decided that the purpose of the Association shall be, by frequent informal meetings, to stimulate good fellowship and to continue and increase interest in the welfare of the College in those who have at any time or in any capacity worked in Peking in connexion with it, and have now entered other pursuits Dr Franklin C McLean, the organiser and first Director of the College, was elected president, Dr E V Cowdry, secretary-treasurer, with Dr A B Macallum, Dr Charles Packard, and Dr Donald D Van Slyke, members of the council It is intended to establish branches of the Association, of which New York is the headquarters, wherever such may be justified, but particularly in Chicago, San Francisco London, Tokyo, and Shanghai The first meeting of the Association will be held at the Marine Biological Laboratory, Woods Hole, Massachusetts, on August 1, when an address will be delivered by the secretary of the Rockefeller Foundation, Mr Edwin R Embree Those wishing to join the Association are requested to communicate with Dr E V Cowdry, at the Rockefeller Institute, 66th St and Avenue A, New York

ON July 12 a new Geophysical Observatory at Jakutsk ($\phi = 62° 01'$, $\lambda = 129° 43'$ from Greenwich) commenced work Organised by the Geophysical Central Observatory, Leningrad, the new observatory represents a local branch of the Central Observatory and consists meanwhile of two sections, dealing with meteorological and the aerological work respectively It is expected that in due course the observatory will be equipped for actinometric, optical, and magnetic observations

SIR CHARLES S SHERRINGTON, Waynflete professor of physiology in the University of Oxford has been appointed a member of the Medical Research Council as from September 30 next The vacancy is caused by the retirement of Dr Henry Head, who leaves the Council under the provisions of the Royal Charter governing the rotation of membership

THE Council of the Royal Meteorological Society has awarded the Howard Prize for 1925 to Cadet H W Barnett of S A T S *General Botha*, South Africa, for the best essay on "Icebergs their Distribution and Drift"

THE following committee has been appointed "to advise as to the proper scope of the Broadcasting Service and as to the management, control, and finance thereof, after the expiry of the existing licence on December 31, 1926" The Earl of Crawford and Balcarres (chairman), Lord Rayleigh, Lord Blanesburgh, The Right Hon Ian Macpherson, The Right Hon W Graham Sir Thomas Royden, Dame Meriel Talbot, Sir Henry Hadow, Captain Fraser, Mr Rudyard Kipling, with Mr W E Weston, of the General Post Office, as Secretary

ON Monday, August 10, the national memorial to Capt R F Scott and his four companions who died on the return journey from the South Pole early in 1912, was unveiled on Mount Wise, Devonport A memorial fund was opened in 1913 by the Lord Mayor of London, and the response has been so generous that, in addition to the memorial at Devonport, a large sum has been set apart to augment Government provision for the sustenance of the families of the deceased men, the outstanding liabilities of the expedition have been discharged, a considerable sum

put aside for the publication of the scientific results obtained, and an institute for polar research has been established at Cambridge The memorial takes the form of a granite pylon surmounted by a symbolic group in bronze with portrait medallions of Capt Scott and his four comrades below

WE learn from *Science* that Dr Raymond Pearl has been appointed director of an Institute for Biological Research established by the Rockefeller Foundation, through its Division of Studies, at the Johns Hopkins University, Baltimore Dr Pearl will retain a connexion with the department of biometry and vital statistics of the School of Hygiene, as research professor in this subject, and will continue as professor of biology in the Medical School The whole time of the staff of the new Institute will be devoted to research on general problems of biology, but with especial attention to the biology of life duration and its control and to the experimental study of the population problem Dr Lowell J Reed has been made professor of biometry and vital statistics and head of the department in the School of Hygiene at Johns Hopkins

THOSE interested in cinematography will read with interest, and doubtless with profit, a communication by Dr K C D Hickman to the Royal Photographic Society on "Colour Vision and the Design of Kine Theatres," which is published in the July issue of the Society's Journal He gives no new experimental results but brings together many physical and physiological facts and discusses their effects on practical results

AT the end of a review entitled "Industrial Research in Cotton" (NATURE, August 1, p 164) it was stated that the volume under notice, the Shirley Institute Memoirs, is not purchasable We now learn that bound copies of the Memoirs can be obtained, price one guinea, from the secretary of the British Cotton Industry Research Association, Shirley Institute, Didsbury, by non-members of the Association

APPLICATIONS are invited for the following appointments, on or before the dates mentioned A lecturer in transport in the University of Birmingham—The Secretary (August 20) A lecturer in the department of electrical engineering of the Bradford Technical College—The Principal (August 29) A professor of education at Armstrong College—The Registrar, Armstrong College Newcastle-upon-Tyne (September 8) A professor of civil engineering in the University of the Witwatersrand, Johannesburg—The Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, W C 2 (September 14) A lecturer in bacteriology in the University of Birmingham — The Secretary (September 26) A second laboratory assistant in the department of Biochemistry, Oxford—The Department of Biochemistry, University Museum, Oxford An assistant bacteriologist at the Wellcome Tropical Research Laboratories, Khartoum — The Director, Wellcome Tropical Research Laboratories, c/o The Controller, Sudan Government, London Office, Wellington House Buckingham Gate, S W 1 A half-time demonstrator in botany in McGill University, Montreal—The Secretary

Our Astronomical Column

PHOTOMETRIC METHODS APPLIED TO VARIABLE STARS —Dr W J S Lockyer Director of the Norman Lockyer Observatory Sidmouth, has recently contributed a very interesting study of the interesting star ϕ Persei ("The Spectrum of ϕ Persei, Type BoPe," Monthly Notices, R A S, 85 580, May 1925) The principal feature of the spectrum is the composite nature of the hydrogen lines and of the ionised lines of several metals of which iron is the most prominent For example, H_β consists of a broad absorption band on which is superposed a bright emission band of lesser width, on which again is superposed a sharp absorption line The ionised metallic lines, however do not show the broad absorption band associated with the hydrogen lines From observations made more than twenty years ago on the cyclical positional changes of the absorption lines, the star was recognised as a spectroscopic binary with a period of 126½ days Lockyer's recent observations refer more particularly to the components of the bright emission bands—of H_β, for example The relative intensities of the two components were measured by the wedge method employed in the determination of spectroscopic parallaxes In this way cyclical changes were detected, and the resultant period found by Lockyer agrees precisely with the period derived from various line-of-sight investigations

It would appear that this is the first occasion on which the periodicity of a star has been determined by the wedge method There are indications in addition, that, superimposed on the 126½ day period, there is a subsidiary period of 21 days, further observations would appear to be necessary to establish this definitely and more precisely An interesting suggestion from Lockyer's paper is that ϕ Persei should be a variable star of period 126½ days, and it is hoped by means of photometric observations to test this suggestion in the near future

NEW STAR ATLAS, SHOWING FAINT STARS —Mr Max Beyer, in conjunction with Prof K Graff, of Bergedorf, is bringing out a very useful set of star maps, including all stars down to magnitude 9 3 and fainter ones if meridian places are available The first 12 sheets are now ready, they comprise the equatorial zone from +22° to −23° each sheet covers 2 hours of R A, the scale being 1 cm to a degree The epoch is 1855, but as centennial precession is marked at six points on each map, reduction to other epochs is easy Nebulæ and star clusters are marked with crosses There is no lettering or nomenclature on the maps themselves but stars can be quickly identified by their co-ordinates A slight blemish is the absence of indication of variability Thus Mira Ceti is shown as an ordinary star of the sixth magnitude (its mean value) These maps should be of great assistance in finding comets and minor planets, or in recognising variables or Novæ The price of the 12 sheets is only 15 marks—little more than a shilling a sheet—and a reduction of twenty per cent is made to those purchasing three sets The whole sky north of Decl −23° will be completed in 30 charts The scale is of course less than that of the Bonn maps, but it is sufficient for the identification of objects

Research Items

BRUNO'S METAPHYSICS AND GEOMETRY —"La Doctrine Metaphysique et Geometrique de Bruno," by Dr Xenia Atanassievitch (Paris Les Presses Universitaires de France), is not only a fascinating historical study of the great sixteenth-century pioneer of modern science but it is also of first-rate present scientific interest Dr Atanassievitch would appear to be a pupil or a colleague of Dr Petronievics, the professor of philosophy at Belgrade, recently in Great Britain working at the reconstruction of Archæopteryx and advocate of a finitistic theory of space, that is the theory that space is composed of discrete units and is not continuous Dr Petronievics holds that only by means of such a theory is it possible to reconcile the paradoxes of Zeno, and we may discover the original form of his argument in this study of Bruno Like Lucretius, Bruno set forth his philosophical arguments in metrical form, and there can be no doubt that his writings influenced very definitely the mathematical and physical sciences in the seventeenth century The change which took place in the method of scientific research under the lead of Galileo and Descartes was largely to the credit of mechanical inventions,—the telescope and the microscope—and it is of extraordinary interest to compare the unaided speculations of Bruno with the new form the theories assumed under the control of experiment All the distinctions which exercised the philosophers of the seventeenth century—the distinction between the mathematical the physical, and the metaphysical unit, the geometrical difficulty Descartes encountered in his conception of subtle matter and his rejection of the void, the difficulty for physics which Malebranche discovered in the idea of a minimum sensibile, the metaphysical difficulty Leibniz met with in relating God to the monads—are expounded in Bruno, mixed up indeed with much fantastic mythology In the valuable criticism which follows her able exposition Dr Atanassievitch claims for Petronievics that his reconstitution of Bruno's idea is the only satisfactory solution of modern fundamental physical problems

AN ETHNIC THEORY OF CASTE —Dr S Ghurye makes an important contribution to the discussion of the question of caste in India, in a paper appearing in Vol 4 of *Man in India*, in which he considers the bearing of the anthropometric data upon this problem If endogamy is taken as the distinctive feature of caste, arising from a desire of the Aryans to keep themselves free from aboriginal blood anthropometry should show that the physical type of their representatives in Hindustan proper approximates to what may be assumed to have been the original physical type of the Aryans This is the long-headed and fine-nosed type found among the castes of the Punjab and Rajputana regions These regions, from their geographical position must have been the site of Aryan settlements The aboriginal type, on the other hand, may be deduced from the Musahar who, not being within the pale of Hinduism, are like the jungle tribes of Southern India, their chief characteristics being the broad nose and a head which is frequently long but is distinguished from the Aryan head in its absolute measurements As a result of a comparison of types in the castes, it appears that the Brahman of the United Provinces has essentially the same physical type as the Punjabis and the ancient Aryans In physical affinity to the Brahman the castes show a gradation corresponding with social status, and there is a similar state of affairs in Bihar In Bengal and Bombay, however, there is no correspondence between social gradation and physical differentiation As one section —the Brahmans—kept itself free from aboriginal blood, while there are intermediate types between it and the representatives of the aborigines, it would appear that the immigrant Aryans of Hindustan tried to impose upon themselves endogamous rules, but only a section carried them out, while others mixed with the aborigines to a greater or less extent

INSECT FAUNA OF THE BRITISH ISLES —In the issues of the *Entomologists' Monthly Magazine* for April, May and June there are records of several interesting additions to the fauna of the British Isles In the April number of that journal Prof E V Theobald describes seven new species of aphides from various parts of the country In the same issue, Mr F G R Waters records three species of small tineid moths which although known previously from Germany and other countries, had not until recently been detected as British The species *Brachmia lutatella* H -S occurs on the Dorset coast, *Coleophora antennariella* H -S was found in beechwoods in Oxfordshire and *Phyllocnistis tremulella* (F R) Zell seems to be more widely spread and has been apparently confused in collections with an allied species There is also an article by Mr J Edwards recording the capsid bug *Miris trispinosum* Rent as British In the May and June issues, Mr G T Lyle enumerates several parasitic Hymenoptera of the family Braconidæ as new to the British Isles The June number of the journal also contains a paper by Mr J V Pearman who brings to notice four species of "book lice" (Psocoptera) which have not previously been known as British, and one of these *Embidotroctes rectivenis*, is described as new to science In the same issue, also, Mr K J Morton records a caddis fly (*Mystrophora intermedia* Klap) not previously known as British—the species being found in the Lake District It is not a little remarkable that so many additions to our well-worked fauna should have been recorded in such a short period, there are evidently still many species in the more obscure groups awaiting recognition

THE SWARMING OF ANNELIDS —L Fage and R Legendre continue (*Comptes rendus Acad Sci Paris*, t 180, p 1373, May 1925) to give results of their experiments in fishing for swimming annelids in the sea by attracting them to strong lights hung in the water In the present communication, they describe the swarming of the mud-burrowing worm *Scalibregma inflatum* Rathke in the Bay of Concarneau The worms were sexually mature and swollen with eggs and spermatozoa, the latter being discharged into the water by the bursting of the body wall The worms gathered round the submerged light and maintained constant and very active revolving and serpentine movements They were found in October, November and December 1923, but the observations were not sufficiently frequent to determine whether in this case there was any lunar periodicity in the swarming of the sexual shoals, such as the authors had previously shown to exist for certain other annelids

LOCATING HERRING SHOALS BY AIR-CRAFT —A series of experiments was undertaken during the month of July 1924, by the Scottish Fishery Board, with the co-operation of the Air Ministry, to ascertain the practicability of locating herring shoals in Scottish waters by means of air-craft An account of these experiments, prepared by the two observers, Messrs Henry Wood and George McGee, has now been

published by H M Stationery Office (Fishery Board for Scotland, Scientific Investigations, 1925, No 1 Edinburgh and London H M Stationery Office, 2s 6d net) Three flying boats were used, based on Invergordon, and repeated flights were made over the whole area of the Moray Firth The weather conditions were on the whole favourable, but only on one evening (July 31) during the course of the experiments was a shoal of herring definitely observed playing at the surface Although the experiments were pursued with great diligence and care, and many observations of interest were made, the report shows clearly that the use of air-craft for the purpose of locating fish in these northern waters cannot be considered as a practical commercial proposition

FLORA OF THE MALAY STATES —The first local flora for the Federated Malay States is that recently published for Taiping by I H Burkill and M R Henderson in the *Gardens' Bulletin*, vol 3, Nos 9-12, for March 1925 In 1894 C Curtis published a list of plants and ferns for the Island of Penang, and in 1900 H N Ridley published his flora of Singapore, both these appearing in the Journal of the Straits Branch of the Royal Asiatic Society, the present authors point out that the fact that Sir Hugh Low was Resident at Taiping from 1877 until 1889, coming there from Borneo, from whence he had already introduced many interesting species into cultivation, has had the natural result that the materials are already available for a relatively complete account of the flora of this area in the Federated Malay States In the flora 1980 species of flowering plants are recognised, 41 of these have been introduced, 1939 are natural to the country The authors contribute a brief account of the habitat and ecology and an analysis of the probable sources of the flora with a very interesting discussion of the 860 species endemic to the Malay peninsula

ORIGIN OF PETROLEUM —Strong evidence in support of a micro-biological origin of petroleum emerges from the results of a recent geological survey of a large district occurring to the west of Los Angeles, California Both Eocene and Miocene shales here abound in the remains of minute organisms which at death sank to the bottom of the sea and formed oozes composed essentially of their own remains Of these organisms diatoms with their characteristic siliceous tests are the most conspicuous, calcareous tests of foraminifers, together with a few siliceous radiolarian skeletons, have also been identified The oozes thus formed are, according to Mr W S W Kew (Bulletin 753, United States Geological Survey), probably comparable to the diatom, globigerina and radiolarian oozes now in process of formation in the ocean, though not necessarily in deep water The process of formation of petroleum from the organic matter from within the siliceous and calcareous tests is bound up with chemical change influenced by geological conditions of pressure and moderate heat An indirect proof of such an origin of oil in this region is furnished by the fact that commercial quantities are recoverable from sandy reservoirs which overlie or are associated closely with these diatomaceous shales, and in the case of the Sespe formation (Eocene-Oligocene) oil is never found unless the Eocene shales are present beneath it In view of the enormous quantities of petroleum recently produced from the Los Angeles region, it is noteworthy that the author is of the opinion that a first essential to the accumulation of oil "over all of California" is that the mother-rock of the oil is present, in other words, that oil has not migrated from great stratigraphical or geographical distances In most cases in this region, the mother-rock is involved in the very structures from which petroleum is ultimately obtained

SIZES OF CRYSTAL UNITS —Recent redeterminations of the sizes of the crystal units of cæsium tri-iodide and dibromo-iodide by R M Bozorth and L Pauling, recorded in the Journal of the American Chemical Society for June, are not in agreement with the values determined by Clarke and Duane (1923) The latter authors used a new method of crystal analysis which they had devised, since Bozorth and Pauling adopted the spectrum and Laue photographic method, the above discrepancy in results is of some importance

THE ACTION OF RADIATION ON GASEOUS MIXTURES —It has been shown by Franck and Cario that, when hydrogen containing mercury vapour is illuminated with light from a mercury arc lamp so as to excite the mercury atoms, the hydrogen becomes dissociated by a secondary reaction due to collisions of the second kind In the *Zeitschrift fur Physik* of June 30, Dr H Senftleben describes an investigation in which this fact is made use of to study the change in heat conductivity of hydrogen when dissociated A mixture of dry hydrogen and mercury vapour is introduced into a glass tube with a quartz window, or into a quartz tube, through which passes a wire heated by an electric current to about 100° C above room temperature The resistance of the wire is measured while the heating current flows, and the tube is illuminated with a mercury arc lamp Owing to the increase in heat conductivity of the illuminated hydrogen, the temperature of the wire fell as indicated by a drop in its resistance The results are of a preliminary nature, but show that the observed effect is really due to alteration in the thermal conductivity of the hydrogen, due to dissociation produced by the incident light Theory shows that the coefficient of thermal conductivity depends on the number of degrees of freedom of the gas molecule, the mean molecular velocity and the molecular diameter All these are altered when dissociation takes place, and the effect of alteration of the last quantity is the most important, since conductivity varies inversely as the square of the molecular diameter, so that dissociation results in an increase in conductivity

HIGH FREQUENCY INDUCTIVE ELECTRIC FURNACE —M G Ribaud describes in the *Comptes rendus* of the Paris Academy of Sciences for June 8, an electric furnace with which temperatures above 3000° C can be obtained, which can easily be opened when hot and can be used repeatedly without renewal of parts It consists of a cylinder of graphite, which is heated inductively by means of a high-frequency current, and a cylinder of porous carbon made of large grains, only slightly compacted, and forming a very poor conductor both for heat and electricity This cylinder forms a continuation of the graphite one, and is closed by a plug of the same porous carbon with a central piece, closed by a glass plate, through which a current of inert gas circulates to remove all fumes and facilitate photometric pyrometry If the portion of the furnace composed of porous carbon is long enough, at least 8 cm, it is possible to remove it by hand, even when the interior of the furnace is at a temperature of 3000° C Temperatures higher than this have been obtained using 10 kilowatts, with a volume of 100 c c, 2500° with 500 c c, and 1800° with 3000 c c As compared with this, a resistance furnace formed of rings of graphite piled one on another, studied at the National Physical Laboratory by Rosenhain and Pryor, gave 1700° C in a volume of about 500 c c, with 10 kilowatts

The Third International Congress of Entomology

THE third International Congress of Entomology, held at Zurich on July 19-26, was attended by about 200 representative entomologists and about 50 guests including 40 ladies The Congress proved a great success More nations were represented than at Brussels or Oxford, and it was a matter of regret that France, Italy and Belgium were not officially represented One is glad to add, however, that the rate of exchange unfavourable to these countries was a contributory cause to the absence of men who will be welcomed at the next conference three years hence During the Congress, members had opportunity of examining the fine collections in the adjoining Entomological Institute and the University Zoological Museum, as also the collection of Prof Standfuss and the palæarctic collection of Dr Corti The Concilium Bibliographicum also received its quota of admiring visitors

The town of Zurich itself, in the fine weather of the week, with its famed Lake, received the usual meed of praise, and especially it showed to great advantage as it was viewed during the ascent of the Uetliberg by funicular railway on one of the Congress excursions, while in the descent in the dark, the lights of the numerous buildings dotted all over the hillside suggested so many majestic glow-worms

The Congress was opened by Dr A von Schulthess, its popular president, who took occasion to emphasise the successes of the early Swiss entomologists He was followed by the Rector of the University, Prof Dr Bleuler, who gave the delegates a cordial welcome on behalf of the Canton of Zurich and of the University Dr Bleuler, besides emphasising the great importance of insects in the spread of various diseases, referred to the psychic problems underlying insect life and habits, a branch of the subject to which Swiss entomologists have made valuable contributions

The forenoons were devoted to general meetings, the afternoons to sectional ones It is impossible to name all the papers presented as this summary can only be a general one As regards the forenoon meetings, Dr F Ris (Switzerland) read an interesting paper on the geographical distribution of insects in Switzerland, dealing first of all with the effects of glacial times, when Switzerland was covered with ice, and going on to quote examples of the influence of man on the relationship between animals and plants Prof Leiper, of the London School of Tropical Medicine, spoke on "Some Outstanding Questions in Medical Entomology" He quoted instances of the already proved relationship between diseases due to protozoa and worms conveyed by insects or arachnids, and named numerous other important diseases in which a "vector" insect or arachnid host might be justly suspected More accurate knowledge regarding these is greatly desired, and a strong plea was made for the co-operation of the parasitologist and the economic entomologist

The fascinating subject of mimicry never fails to attract a large audience As regards the explanation of specific instances—teleological, physiological, chemical, mechanical, and so on—one can only say "*Tot homines quot sententiæ*" On the present occasion, Prof E B Poulton, of Oxford, who has done so much for the success of the three International Congresses, and Prof van Bemmelen, of Holland, were the protagonists The debate between these two experts was a model of how such a controversy should be conducted Their mode of presentation of the subject, and their manner of differing, won the listener, who was tempted to throw logic to the winds and wish or even declare that the debaters were both right, as of course up to a point both were Prof Poulton illustrated, by means of coloured figures and actual specimens, mimicry in African butterflies of the nymphaline genus Charaxes, and pointed out new aspects of the subject The genus Charaxes is one of powerful fliers and yet there is much mimetic association They often mimic each other in pattern, as is most evident in the females of the smaller species, which resemble the males as well as the females of larger species Dr Richard van Someren has proved by breeding from known female parents that three of these mimics in Uganda, although totally different in appearance, are the females of the same species Mr C F M Swynnerton has shown that the quality mimicked in this case is the quality of "fighting weight" and toughness, rendering the butterflies, and especially the larger species, very difficult to hold and reduce to a condition in which they can be comfortably swallowed Prof van Bemmelen argued that different mimetic patterns are derived from a common ancestral pattern and need not imply any mimetic association

At another meeting mimicry was brought up again by the veteran Father Wasmann, in his address on the staphylinids which live in happy association with certain ants This was only one of several weighty pronouncements from Father Wasmann, as, for example, his contribution to the discussion on Dr H Eidmann s paper on "The Foundation of Colonies in Ants" Setting aside the foundation of a new colony by secession, there are two principal types of sexual reproduction of an ant colony One is the independent or autonomic colony foundation where the fertilised female is able to found a colony by herself and without any aid In the other case the female requires, for rearing her young larvæ, the help of other ants One type of these is the red slave-working ant *Formica sanguinea* which lives in mixed colonies with workers of *Formica fusca* Eidmann isolated a fertilised queen of *F sanguinea* and after a fortnight put her into an artificial nest consisting of some twenty workers and one hundred cocoons of *F fusca* The introduced queen attacked the workers, killed one after the other in severe fight, and took possession of the cocoons She looked after the cocoons and in a short time had a little troop of newly issued slave ants to help her to rear her eggs and larvæ

Mr F Balfour Browne, of Cambridge, spoke on "The Evolution of Social Life among Caterpillars," basing his argument on a number of illustrated cases chosen from the Lepidoptera, beginning with the silk-spinning habit as protective and going on to feeding nest or web, and then to home nests C B Williams, of Egypt, spoke on "Some Unsolved Problems of Butterfly Migration," quoting interesting examples and inviting co-operation and exact observation

Instructive papers on the history and progress of the study of entomology in different countries, in its various branches, were given by Escherich for Germany, Tragardh for Sweden, Mokozecki for Poland, Fletcher for India, and Urich for the West Indies

As regards the sectional meetings many valuable papers were read, and it may safely be hazarded that the volume of the Proceedings of the Congress will be found very helpful to entomological workers all over the world It is impossible in this summary to mention all the individual papers The sections were (1) Morphology, Anatomy and Physiology, (2) Systematic and Geographical Distribution, (3) Nomenclature and Bibliography, (4) Biology and Development, (5) Applied Entomology, and it must

suffice to say that there was no lack of material or of discussion. As the various sections met at the same hour, it was not easy always to decide which paper to miss, so that with a choice of good things one often wished, like Boyle Roche's bird, to be in two places at the same time. Of such papers as I managed to hear myself, I may mention Horn of Berlin on systematic entomology, Edwards on the phylogeny of nematocerous Diptera, the Aphid papers of Borner, Davidson and Munro, Pictet on parthenogenesis, Prell on Polyeder diseases of insects, Brun on the anatomy of the brain, and Jablonowski's papers in the Economic Section. To listen to Jablonowski "annihilating time and tearing a passion to tatters" was one of the treats of the Congress. The wide appeal of the Congress will be gauged if in addition to the names already given I mention Handlirsch of Vienna, whom one was glad to see taking an active part again, Nuttall and Scott of Cambridge, Ettringham of Oxford, Carlier of Birmingham, Heymons, Schwaitz and Schubeig of Berlin, Eckstein of Eberswalde, Reh of Hamburg, Everts of Holland, Johannsen of the United States, Lord Rothschild and Jordan of Tring (the Congress owed much to Jordan's organisation and committee work), Marshall and Neave of the Imperial Bureau of Entomology, Waterston and a worthy representation from the British Museum, Blendowski of Poland, Rennie from Scotland, Turati from Italy, Kryger from Denmark, and Monzen of Japan, and a naturally large representation of well-known Swiss entomologists. A special tribute must be paid to Dr. L. O. Howard, of the United States Department of Entomology. Always in a position to help and using his position to help, Dr. Howard has earned the gratitude of entomologists everywhere. Capable and kindly, always with the right word, and with tact as his middle name, Howard gives one the feeling that were there a dozen representative ambassadors like him in the political world we would soon have, what some of us long for, the United States of Europe, each nation no longer at enmity with the other but working out its own salvation following the lines of its own culture and psychology. Certainly there was a spirit of friendliness and goodwill at the Congress, attesting that science has no limited boundaries but is international.

Much hard committee work was done during the week, and the Section on Entomological Nomenclature has so co-ordinated opinions from various sources that hopes are high for general agreement. The nomenclature question is in some ways an appalling one to tackle, and it is surprising the amount of time and labour expended in trying to reach an international system that would be clear and consistent.

The position of systematic entomology and the status of the systematist in university and museum were also subjects of committee work, and the Congress passed resolutions that are satisfying. In the economic sections also, attention has been focussed on the need for a recognition of the deeper problems underlying entomological research, and the Congress passed the following resolution: "The Congress considers it essential that the problems underlying Applied Entomology should be studied, and desires to impress upon Governments and Institutions concerned with investigations in Applied Entomology that time must be devoted to Systematic Entomology and fundamental research, such as Insect Physiology, Ecology and Pathology, since only by the study of these can insect control be placed on a sound basis."

This report is already long else one would have liked to mention some of the more humorous features of the week's meeting. Only one can be mentioned. A steamer heavily laden with the members of the Congress, in a sail round Lake Zurich, reached a certain little town at dinner-time. "The Assyrians came down like a wolf on the fold" or, entomologically, the locusts swarmed ashore to find that the village Chief of the Commissariat had blundered and food failed. But this was a meeting of biologists, and soon was seen in practice Natural Selection working through the struggle for existence and the survival of the fittest—the badge of the fit taking the guise of half a sausage. Whether the raiding habits developed in the struggle will become an acquired character time alone can show. One is glad to add, however, that as opposed to "Nature red in tooth and claw" the co-operative and ethical aspect of the struggle for existence received due illustration.

On the evening preceding the close of the Congress a banquet was held and every one enjoyed the night's social leisure. On the last day of the Congress two papers were read and the Congress then resolved itself into a Business Meeting. The president was heartily congratulated on a highly successful meeting.

Several extra excursions were arranged to follow the close of the Congress, *e.g.* to the Rigi Summit and the Jung Frau.

R. STEWART MACDOUGALL.

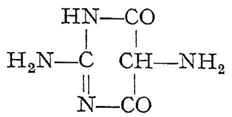
Lathyrism.

OF the chronic diseases which are directly related to the food supply and only indirectly connected with the presence of infective agents, most attention has in recent years been paid to that group in which the symptoms are due to the *deficiency* of some element in the diet, more especially that of one of the vitamins; scurvy, beri-beri, and probably rickets are among the diseases in this class. The other group, of which ergotism is the best known example, is due to the *presence* in the food consumed of small quantities of some poison, which after prolonged administration affects various organs of the body with the production of symptoms. The chronicity of the disease distinguishes this group from cases of acute poisoning due to bacterial products taken with the food or to the ingestion of some well-known poisonous substance.

The occurrence of lathyrism, which has been met with in India and in countries bordering on the Mediterranean, has been for long ascribed to the consumption of the seeds of pulses of the genus Lathyrus. In India the seeds of *Lathyrus sativus*, known in the vernacular as *khesari*, occupy a large place in the diet in certain districts, in which also a form of paralysis is frequently seen, especially among those who utilise the pulse as the staple article of their diet. L. A. P. Anderson, A. Howard, and J. L. Simonsen (*Indian Journ. Med. Research*, 1925, vol. 12, p. 613) have recently conducted an investigation into this disease, from the results of which certain important conclusions can be drawn. At the outset of their work, the investigators recognised that the crop of *Lathyrus sativus* is scarcely ever grown in pure culture, but is frequently contaminated with various weeds; the seeds of one of these, the vetch *Vicia sativa*, L. var. *angustifolia*, were present in every sample of *khesari* obtained from districts in which lathyrism is common; attention was thus attracted especially to this weed, which is known in the vernacular as *akta*. As the result of both chemical analysis and feeding experiments with ducks and monkeys, the important conclusion was reached that pure *khesari* seeds contain no alkaloids; in fact they form a nourishing diet for these animals.

Quite different results were obtained with the seeds

of the vetch *akta* Chemical analysis has confirmed the results of previous investigators, at least two glucosides are present one vicianin closely related to amygdalin the other, vicine yielding on hydrolysis δ-glucose and the base divicine The latter is an oxy-amino derivative of pyrimidine with the formula



Animal experiments have shown that divicine sulphate or hydrochloride is definitely toxic, doses of 0 6 mgm per gm body weight injected subcutaneously into young guinea-pigs produced convulsions lasting for about an hour, followed by paralysis and death in a few hours, post-mortem examination disclosed congestion of many of the organs, especially the central nervous system, and a peculiar rose-pink staining of the medulla of all the bones this colour is the same as that assumed by solutions of divicine hydrochloride on exposure to the air, and its occurrence is considered by the authors to be evidence that the base is actually absorbed after injection Injections of vicine or vicianin in similar amounts produced no ill effects which could be attributed to the substance injected the experiments do not exclude the possibility that larger doses may be harmful or that if vicine is taken with the food it may be hydrolysed into glucose and divicine during digestion

The feeding experiments with ducks and monkeys also appear to be almost conclusive In the case of the former only birds on a diet containing *akta* have shown any symptoms and the majority of those on these diets have been affected The syndrome is characteristic the symptoms being referable to an affection of the nervous system and including ataxia and paresis, early death is the rule The incidence of symptoms in the case of monkeys on diets containing *akta* has not been quite so general, and the symptoms themselves have usually been less well defined, but in every case they can be referred to a lesion of the nervous system no characteristic symptoms have been shown by any animal on *khesari* unless *akta* was also present in the food In neither case are the symptoms those of typical lathyrism in man, although some of those occurring in the monkeys have been observed in human beings But so frequently do the effects of similar agents differ in animals and man, that the difference observed here seems to be no objection to the application of the authors' results directly to the latter Thus the important conclusion is reached that lathyrism is due to the consumption of the seeds of the vetch *Vicia sativa*, a weed which frequently contaminates the crop of the pulse *Lathyrus sativus* Hence it should be possible to exterminate the disease by ensuring that the crop is grown pure

The Museums Association

ANNUAL CONFERENCE

THE thirty-sixth annual conference of the Museums Association was held at Exeter on July 6-11, when more than 120 delegates attended A civic welcome was extended to the delegates by the Mayor of Exeter The president of the Association for the year 1924–25 was Mr F R Rowley, the Royal Albert Memorial Museum Exeter The president in his address [1] gave a brief resume of the museum movement in Exeter, and traced the development of the Museum from its small beginnings more than a century ago He then discussed the question of a Royal Commission on museums In pressing the claims of the provinces to a wider measure of support, he said they are actuated by no spirit of antagonism to the claims for increased expenditure which is being advanced by museums in the metropolis Following on this he dealt with the wasteful destruction of wild life which threatens the very existence of some of our indigenous plants and animals

Mr Robert T Jackson, of Peterborough, U S A, read a paper on " Ink and Paper for Museum Labels " giving his experiences over a long period on this subject Major Stanley S Flower contributed a paper and opened a discussion on " The Scientific Value of Small Aquaria " He emphasised the value of keeping data with regard to the animals kept in small aquaria, as much information about the longevity of these animals might thereby be obtained

A paper on " Botanical Modelling for Museum Purposes " was read by Mr W E Mayes, Leicester He described in detail the process of modelling various specimens and showed examples of his own work in this connexion Dr F A Bather discoursed on " A Cargo of Notions from America," and described in detail the system adopted in American museums to aid visitors in their survey of the various departments He emphasised the fact that the museums in the United States are far ahead of those in England in the use of electric light for the lighting of museum cases Mr W Stanley Lewis, head of the Department of Geography in the University College of Exeter read a paper on " The Place of Museums in the Teaching of Geography " He suggested that good might result from a conference between such bodies as the Museums Association and the Geographical Association The last paper was by Mr E Rimbault Dibdin, who discussed " The Proper Function of a National Gallery " He remarked that the authorities of the National Gallery complain of lack of space but he considered that it would be better if the Gallery was given up wholly to foreign art and all British pictures were transferred to the British Gallery at Millbank

Several trade exhibits were displayed during the Conference as well as exhibits by individual members Of exceptional interest was a special exhibit of Old Exeter and Devonian Silver of the sixteenth, seventeenth and eighteenth centuries The social side of the conference was not neglected On Tuesday evening the Mayor gave a reception to the delegates at the Royal Albert Memorial while the local committee entertained the delegates to lunch The local programme included a visit to the Exeter Historical Museum and the Cathedral, where a short organ recital was given by Dr E Bullock The party was afterwards conducted over the Cathedral The delegates also paid visits to places of interest in the city Miss M Tothill, the curator, addressed the party on the St Nicholas Priory, and an inspection was made of the Hall of the Weavers, Fullers and Shearmen, the Hall of the Vicars Choral and Bampfylde House An address on the city muniments and regalia was delivered by the Town Clerk (Mr H Lloyd Parry) in the Guild Hall An excursion took place to Bradfield, the home of the Waldron family, by invitation of Commander and the Hon Mrs Adams, while the Sheriff of Exeter entertained all the delegates at a garden party in the Rougement Gardens

[1] The presidential address and the papers and discussions will be published in the *Museums Journal*, commencing August 1925

University and Educational Intelligence

CAMBRIDGE.—Mr. J. A. Carroll, Sidney Sussex College, has been appointed University lecturer in astrophysics. Mr. G. U. Yule, St. John's College, has been reappointed University lecturer in statistics. Dr. A. H. Evans, Clare College, has been appointed a member of the Council of the National Trust for Places of Historic Interest or Natural Beauty. A. Lourie, St. John's College, has been nominated to the Choate Memorial Fellowship at Harvard University. W. A. H. Rushton, Emmanuel College, has been elected to the Michael Foster Research Studentship in Physiology. C. S. Deakin, Queen's College, and W. B. C. Perrycoste, Sidney Sussex College, have been awarded the John Winbolt Prize for a joint dissertation on the "Theory of Transverse Oscillations of Girders."

The Botanic Garden Syndicate reports the addition of 85 specimens of rare species of the genus Rosa, presented by Mr. C. C. Hurst, also a valuable collection of species of Iris, mostly collected wild, from the executors of the late Hon. C. N. Rothschild. An alpine house has been presented to the Garden by Mr. J. Cherrington.

On the occasion of the meeting of the International Astronomical Union at Cambridge, the honorary degree of Sc.D. was conferred upon President Campbell, M. Baillaud, Prof. de Sitter, Prof. Nagaoka, and Prof. Schlesinger.

The joint coal-mining diploma of the Universities of Cambridge and Birmingham has been approved by the Board of Trade.

DR. G. M. SHRUM, who has been associated with the low temperature laboratory at the University of Toronto since its inception, has been appointed assistant professor in physics at the University of British Columbia, Vancouver, B.C.

THE following awards for the year 1925–26 have been made by the Salters' Institute of Industrial Chemistry and approved by the Court of the Company:—1924–25 fellowships have been renewed to Mr. H. H. Evers, University of Liverpool; Mr. K. Knight Law, University College, Nottingham; Mr. H. S. Pink, University College, Nottingham, and University of Oxford; and Mr. V. E. Yarsley, the University of Birmingham. Fellowships have been awarded to Dr. R. Campbell, Armstrong College, Newcastle-upon-Tyne, and University of Oxford, and Mr. R. O. Gibson, University College, London. The Salters' Institute has also awarded 70 grants in aid to young men employed in chemical works in or near London to facilitate their further studies.

AT Budapest an English College is to be established under the auspices of the Ministry for Religion and Public Instruction. Each year twelve students of the College will proceed to Great Britain for further study in one or other of the Universities of Oxford, London, and Aberdeen. Three years ago, Hungary's economic situation was so desperate that an inter-university committee was formed to save scientific workers from having to abandon their work owing to lack of equipment and means of subsistence. In a report by Prof. Emile de Grósz on the three years' activities of this committee, it is stated that the Rockefeller Foundation has made grants for travelling scholarships and sends 70 periodicals in the English language, while a German society sends 261 German publications for the use of the universities, and the American Science Extension Committee proposes to arrange exchanges of American and Hungarian scientific workers.

Societies and Academies.

COPENHAGEN

Royal Danish Academy of Science and Letters, October 17.—C. **Wesenberg-Lund**: Contributions to the anatomy and biology of the genus Zoothamnium. During two years' study of *Z. geniculatum*, special attention has been paid to the so-called macrogonidia, their origin and significance for the formation of new colonies.

December 12.—N. E. **Nørlund**: A table of the Riemann zeta function.—Harald **Bohr**: New proof of a general theorem of Kronecker on diophantine approximation.

January 9.—N. **Bjerrum** and L. **Ebert**: On some recent investigations concerning transference numbers and amalgam equilibria in mixtures of strong electrolytes. Some new experimental investigations, which have been regarded as incompatible with the hypothesis of complete ionisation of strong electrolytes, are discussed and explained from the view-point of this hypothesis.

January 23.—C. G. Joh. **Petersen**: How do whales swim? Whales swim by moving the caudal fin up and down; this is accomplished by means of the tail with its strong muscles, whereas the proper muscles of the caudal fin give this fin the rigidity suitable to the speed. When the speed is high, only small movements are made, for which reason the animal then only appears to quiver; the movements, therefore, are difficult to observe.

February 6.—Th. **Mortensen**: Antarctic zoogeographical studies. The study of the marine fauna, especially the echinoderms, supports the theory of a previous land connexion between Antarctica and South America (the Magellanic region). The Kerguelen group must also have been directly connected with that region. On the other hand, the so-called "subantarctic" islands, New Zealand, the Auckland-Campbell Islands do not, as regards their echinoderm fauna, belong to the subantarctic region, but form a part of the New Zealand region. The correspondences between the Australian and the New Zealand echinoderm faunas would seem to be more naturally explained through Wegener's continental drift theory.

February 20.—N. **Bohr**: On the law of conservation of energy. The attempts to develop an atomistic interpretation of directly observable phenomena have led us to recognise the necessity of revising the ideas hitherto underlying the description of natural phenomena. Our present conceptions would not seem to allow of a detailed description of atomic processes which presumes the law of conservation of energy, which occupies a central position in the classical description of Nature.—C. Tate **Regan**: Dwarfed males parasitic on the females in oceanic angler-fishes (*Pediculati Ceratoidea*). (Proc. Roy. Soc. London B, vol. 97, 1925.)

SYDNEY

Royal Society of New South Wales, June 3.—A. R. **Penfold**: The essential oil of *Boronia citriodora* and the occurrence of citronellol. *B. citriodora* belongs to the snow regions where it thrives, being especially abundant around Cradle Mountain, Moina, Tasmania. The leaves and terminal branchlets yielded from 0.75 per cent. to 0.93 per cent. of a sweet odoriferous oil containing citronellol (80 per cent.), citronellol esters (principally acetate with some valerianate, d-a-pinene, sesquiterpene, a paraffin (m.pt., 64-65° C.), etc.

Washington

National Academy of Sciences (Proc vol 11, No 6, June) —O E **Glenn** A note on the abundance of differential combinants in a fundamental system —C N **Moore** On the application of Borel's method to the summation of Fourier's series Borel s method is not so effective as Cesaro's in summing Fourier s series but is more effective than ordinary convergence —S **Lefschetz** (1) Intersections of complexes on manifolds (2) Continuous transformations of manifolds —H S **Vandiver** Laws of reciprocity and the first case of Fermat's last theorem —E W **Berry** A species of Musa in the Tertiary of South America Fossil seeds of a species of Musa have been found in the coal measures of the Cerros de Guadalupe and Montserrate, Colombia, in a horizon probably oligocene The discovery supports the statements of old writers that the banana was a staple food in America in pre-Spanish times —P **Sushkin** Outlines of the history of the recent fauna of palæarctic Asia The fauna is divided into two groups characteristic respectively of the northern zone and the southern or High Asian zone In the northern zone, the indications are that the pliocene climate was humid and mild later there was local glaciation followed by a dry, continental period with steppe invaded by woodland High Asia is characterised by desert, mountain and dry highland types they are of ancient origin but their present dominance is recent Types with broken distribution are characteristic of more fertile conditions There was no large inland basin in High Asia during the Tertiary —A H **Compton** On the mechanism of X-ray scattering Bennett, using two point counters, one to receive the recoil electron and the other the scattered quantum, finds many simultaneous impulses in accordance with quantum theory predictions Simon and Compton, using stereoscopic cloud expansion photographs showing a recoil electron and a secondary β ray track produced by the scattered X-ray quantum, find that the tracks in the majority of photographs are in accordance with the quantum theory prediction The evidence is thus against any spreading wave theory of radiation, which requires that there should be no correlation between the direction of the recoil electron and that of the effect of the scattered quantum —D C **Miller** Ether-drift experiments at Mount Wilson (see Nature, July 11, p 49) —H N **Russell** The intensities of lines in multiplets I Theory, II Observed data (see Nature, May 30, p 835) —R A **Millikan** and I S **Bowen** New light on two-electron jumps Whenever a given type of spectral line progresses linearly with atomic number (irregular doublet law), the electron jumps originating it take place between orbits of the same total quantum number Hot-spark electrometry shows that series of two-valence atoms are characterised by five nearly equally spaced bars, three-valence atoms show four bars These characteristics are due to the simultaneous jumping of two electrons The movement of one electron disturbs the system, causing a fellow-electron to make a similar jump —H M **Evans** and G O **Burr** The anti-sterility vitamin fat soluble E Rats fed on synthetic food mixtures of fat, carbohydrate and protein with an appropriate salt mixture and vitamins A and B grow well, but sooner or later develop complete sterility In the male there is complete destruction of germ cells but in the female ovulation continues though gestation is interrupted by the death and resorption of the developing This condition can be remedied by feeding with certain single natural foods containing the new food factor, vitamin E Vitamin E is fat soluble and remarkably stable to heat light and chemical change, it is present in many animal tissues abundant in leaves and seeds and especially in the wheat embryo Cod-liver oil is notably lacking in vitamin E —Grace **MacLeod**, Elizabeth E **Crofts** and F G **Benedict** The racial factor in metabolism Measurements on seven Chinese and two Japanese women in American colleges showed that the average metabolism of these orientals was about 10 4 per cent less than that taken for American women Even granting the latter should be decreased by 5 per cent, there seems to be a specifically lower metabolic rate for Chinese and Japanese women —C **Voegtlin**, J M **Johnson** and Helen A **Dyer** Protoplasmic action of copper and gold In view of the relative mass of protoplasm and of salts of these heavy metals, and of the relatively large surface exposed it is considered that even in very diluted solutions (1 in 10^7), sufficient metal ions are present to exert a toxic effect by chemical means Glutathione and cysteine have a protective effect, suggesting that the normal toxicity is due to 'asphyxia" from loss of the glutathione normally present in small quantities in tissues —G H **Parker** Activities of colonial animals III The interrelation of zooids in soft corals A mechanical stimulus or light induces only local response in gorgonians the zooids of Renilla are all affected by a local stimulus, suggesting an interconnecting nerve-net —Lucy G **Taliaferro** Periodicity of reproduction, infection and resistance in bird malaria Periodicity of occurrence of high values of mean size of parasites is unaffected throughout the infection, indicating that the rate of reproduction remains constant Some destruction of merozoites always occurs, and this natural resistance factor increases in potency at the crisis and is maintained through the latent period —Emma L **Fisk** The chromosomes of *Zea Mays* A haploid number of 10 chromosomes and a corresponding diploid number of 20 have been found, except in Black Mexican sweet corn, which generally has 22 chromosomes —F G **Pease** Measurement of the spectroscopic binary star Mizar with the interferometer The determinations are in good accord with the results from spectroscopic data —F H **Seares** and P J van **Rhijn** Distribution of the stars with respect to brightness and distance from the Milky Way (see Nature, June 20, p 948) —G **Stromberg** The general distribution of cosmical velocities Group motion varies from 12 km per sec for the Cepheids of long period to about 300 km per sec for stars of maximum velocity dispersion, globular clusters and spiral nebulæ thus the solar motion is dependent on the class of object to which its motion is referred

Vienna

Academy of Sciences, May 14 —F **Kerner-Marilaun** The influence of the variable elements of the earth s orbit on the form of the European temperature chart during the Tertiary epoch By means of Spitaler s calculations for the temperatures of extreme land and sea climates and by means of the author's own method of geographical temperature analysis, it is possible to fix limits to the range within which the distribution of temperature oscillated in Tertiary Europe The influence of the astronomically determined temperature change on the plant world of the Tertiary is indicated, and the floral migrations of deciduous and evergreen plants —G **Sachs** On decomposition of azimenthines by mercury The actions on benzalethylamin, on benzal-benzylamin, and on benzalanilin of mercury chloride and of mercury acetate —H **Handel-Mazzetti** New Chinese plants (xxxiv) Includes five sorts of Quercus and three of Vaccinium

June 12 —K **Przibram** On coloration and luminescence by Becquerel rays —H **Benndorf** Outlines of a theory of the earth's electric field (I) —F **Knoll** On pan-algebraic manifolds —W **Olbrich** New problems in projection —G **Weissenberger, F Schuster** and J **Lielacher** On organic molecular compounds (xiv) Chlorophenol and bromoform —M **Kohn** and G **Soltesz** On a new tri-bromo-phenol, the 1-oxy-3,4,5-tri-bromo-benzol, and a new tri-bromo-cresol, the 1-methyl-2-oxy-4,5,6-tri-bromo-benzol (Sixteenth communication on bromo-phenols)—M **Kohn** and L **Schwarz** Preparation of brominated α-naphthochinon (Seventeenth communication on bromo-phenols)—R **Dworzak** Preparation of di-brom-acet-aldehyd-acetal by direct bromination of paraldehyde —J **Schorn** Macroseismic study of the earthquake of March 26, 1924, and of its after-shocks —A **Schedler** Microseismic study of the earthquake of March 26, 1924 —F M **Exner** On the interaction of water and gravel in rivers Theoretical experimental and photographic work on the sandbanks of the River Mur, south of Graz —H **Handel-Mazzetti** New Chinese plants New species of Hydrangea and Senecio —A **Tauber** On the integration of linear differential equations (Fifth contribution)

June 18 —G **Weissenberger, F Schuster** and J **Lielacher** On organic molecular compounds (xv) Aromatic amines

June 25 —M **Chiba** On the tongue-jaw reflex of the same side and crossed sides —H **Neudorfer** Construction of the principal tangent curves on net-surfaces —H **Jacobi** Influence of various stimuli on the growth of morphologically dissimilar parts of plants Weak solutions of potassium chloride and other salts were used and experiments made with Impatiens, Syringa and Phaseolus Resting plant organs were made to grow Similar salts influence the growth of pollen-tubes —L **Mirskaja** Changes in plants produced by removing the blossoms —A **Smekal** On the influence of the pores of solid bodies on molecular mobility and rigidity Crystals are generally considered to have a solidity which they do not really possess, the lattice structure is liable to microscopic or submicroscopic interruptions and the rigidity of the apparent crystal is much less than the real molecular rigidity Self-diffusion in solid salts may be an internal surface process —G **Klein** and J **Kisser** The assimilation of nitrates by higher plants An inquiry into the stages between nitrate and amino-acid On feeding Phaseolus and Zea with $-NO_3$ in sterile culture solutions, $-NO_2$ and NH_4- appeared in the culture medium, and NH_4- also within the plant —F **Trauth** Geology of the northern Radstatter-Tauern and their foot-hills

July 2 —M **Kohn** and L **Schwarz** On the chinoid product of oxidation of benzal-di-β-naphthol —E **Emich** Further remarks on the rubidium- (cæsium-) silver-gold-halogen salts —J **Vogel** Investigations on rubidium- (cæsium-) silver-gold-halogen salts —E **Reichl** Contributions to the knowledge of the isomorphic relations of the cupro- and silver halogen salts

Official Publications Received

Berichte der Naturforschenden Gesellschaft zu Freiburg i Br Herausgegeben von Prof Dr J L Wilser Vierundzwanzigster Band Erstes Heft Pp 123+92+46+63 Zweites Heft Pp 28+16+8+20 (Freiburg i Br Speyer und Kaerner)

Marconi's Wireless Telegraph Co Ltd Report of the Directors and Statement of Accounts for the year ended 31st December 1924 to be Presented at the Annual General Meeting of the Company to be held at the Hotel Victoria Northumberland Avenue London, W C 2 on Friday, the 31st July 1925, at 12 o'clock noon Pp 8 (London Marconi House)

University of Cambridge Solar Physics Observatory Twelfth Annual Report of the Director of the Solar Physics Observatory to the Solar Physics Committee 1924 April 1-1925 March 31 Pp 7 (Cambridge)

The North of Scotland College of Agriculture Guide to Experiments and Demonstration Plots at Craibstone, 1925 Pp viii+60 (Aberdeen)

University of Bristol Prospectus of the Faculty of Engineering which is Provided and Maintained by the Society of Merchant Venturers in the Merchant Venturers Technical College Seventeenth Session of the Faculty and Seventeenth Session of the College, 1925-26 Pp 32 (Bristol)

City and Guilds of London Institute Report of the Council to the Members of the Institute, 1925 Pp liii+95 (London Gresham College)

Ministerio da Agricultura, Industria e Commercio Directoria de Meteorologia Causas Provaveis das Seccas do Nordeste Brasileiro (Conferencia realisada no Club de Engenhatia no dia 20 de Dezembro de 1924) Pelo Dr J de Sampaio Ferraz Pp 30 (Rio de Janeiro)

Union of South Africa Department of Agriculture Division of Chemistry Series No 53 Science Bulletin No 36 Some Experiments on the Solubility of Saldanha and Grahamstown Phosphates in the Soil By A Stead Pp 15 3*d* Division of Chemistry Series No 55, Science Bulletin No 37 Comparative Results of Analyses of Spirits and Brandies (Read before the Cape Chemical Society on the 22nd August 1924) By F Ferrier Pp 8 (Pretoria Government Printing and Stationery Office)

Proceedings of the Royal Society of Victoria Vol 37 (New Series), Part 1, May 28th Pp iii+129+16 plates (Melbourne)

Loughborough College, Leicestershire Calendar, Session 1925-26 Pp xiv+220+59 plates (Loughborough) 2*s* 6*d* net

South Australia Department of Mines Mining Review for the Half Year ended Dec 31st, 1924 (No 41) Pp 93+9 plates (Adelaide R E E Rogers)

Astronomical Papers prepared for the Use of the American Ephemeris and Nautical Almanac Vol 10, Part 1 Positions and Proper Motions of 1504 Standard Stars for the Equinox 1925 0 Pp 167 (Washington Government Printing Office) 40 cents

Department of the Interior United States Geological Survey Bulletin 759 Geology of the Bristow Quadrangle, Creek County Oklahoma, with Reference to Petroleum and Natural Gas By A E Fath Pp iv+63+13 plates 40 cents Bulletin 760 D Pedestal Rocks in Stream Channels By Kirk Bryan Pp ii+123 130+plates 31 32 Bulletin 763 Geology and Ore Deposits of the Aravaipa and Stanley Mining Districts, Graham County Arizona By Clyde P Ross Pp vi+120+13 plates 25 cents (Washington Government Printing Office)

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Ministry of Finance Egypt Survey of Egypt Geology of Egypt Vol 1 The Surface Features of Egypt their Determining Causes and Relation to Geological Structure By Dr W F Hume Pp xliv+408+122 plates (Cairo Government Publications Office) 50 P T

Mines Department Third Annual Report of the Safety in Mines Research Board, including a Note regarding Matters dealt with by the Health Advisory Committee, 1924 Pp 72 (London H M Stationery Office) 1*s* net

Ministry of Public Works, Egypt Physical Department The Climate of Alexandria By Mahmoud Hamed (Physical Department Paper No 19) Pp iii+62+8 plates (Cairo Government Publications Office) 5 P T

Memoirs of the Geological Survey of India Palæontologia Indica New Series Vol 8, Memoir No 3 The Perissodactyla of the Eocene of Burma By Dr Guy E Pilgrim Pp iii+28+2 plates (Calcutta Government of India Central Publication Branch) 1 9 rupees, 2*s* 9*d*

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Department of the Interior Bureau of Education Bulletin, 1925, No 14 Record of Current Educational Publications comprising Publications received by the Bureau of Education to April 1, 1925 Pp ii+59 (Washington Government Printing Office) 10 cents

Department of Commerce Bureau of Standards Scientific Papers of the Bureau of Standards, No 506 Theory and Interpretation of Experiments on the Transmission of Sound through Partition Walls By Edgar Buckingham Pp 191 219 (Washington Government Printing Office) 10 cents

Union Geodesique et Geophysique Internationale Deuxieme assemblee generale, Madrid, Octobre 1924 Proces verbaux des séances de la section de meteorologie Pp 184 (Rome Imprimerie Pio Befani)

Year Book of the Academy of Natural Sciences of Philadelphia for the Year ending December 31 1924 Pp 93 (Philadelphia)

Imperial Department of Agriculture for the West Indies Report on the Agricultural Department, St Lucia, 1923 Pp iv+25 (St Lucia) 6*d*

Cambridge Observatory Annual Report of the Observatory Syndicate, 1924 May 19-1925 May 18 Pp 4 (Cambridge)

Department of Agriculture Ceylon Bulletin No 72 The Control of Shot Hole Borer of Tea (*Xyleborus fornicatus*, Eichh) By F P Jepson and Dr C H Gadd Pp 46 (Peradeniya) 40 cents

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British Optical Instruments

PROGRESS in nearly every branch of scientific investigation is dependent on the provision of suitable measuring apparatus As the science develops, an ever-increasing degree of accuracy of measurement is required, which in its turn involves a correspondingly higher degree of refinement in the measuring apparatus Many of the measuring instruments employed are essentially of an optical nature, and thus the optical instrument maker has been truly described as the tool-maker for all branches of scientific investigation including his own It is the function and the duty of such a tool-maker to keep himself familiar with the latest advances in science, so as to be able to understand or even to anticipate the requirements of the investigator, and to meet these requirements by the provision of suitable practicable devices That the British optical instrument maker has successfully fulfilled this function was clearly indicated by Mr F Twyman, who, in his recent presidential address to the British Optical Instrument Manufacturers' Association, discussed the capacity of the industry for invention, development, and production His survey contained a record of notable achievements in regard to instrument design and construction of which any body of workers might justly be proud

The economic stringency and the increased competition experienced during the past few years have stimulated the industry to increased efforts towards perfecting the quality and widening the range of its products, and towards improving and increasing its equipment for producing Technically, the industry is in a healthy condition Its research organisation, the British Scientific Instrument Research Association, has already proved of inestimable value In addition, many of the individual firms in the industry actively prosecute research in their own laboratories, and these investigations are not simply directed towards putting forward new processes or improvements, but are often of a fundamental nature This activity in research is reflected in the numbers of papers which have been published in recent years in the Transactions of the Optical Society and elsewhere, giving results of many important investigations carried out by the scientific staffs of optical firms Educational facilities in all branches of technical optics are provided in London at the Optical Engineering and Applied Optics Department of the Imperial College of Science and at the Northampton Polytechnic Institute Thus, the scientific, technical, and educational equipment of the industry is such as to lead one to anticipate a continuance of the notable attainments which have characterised it in the past

The story of these achievements of the British optical instrument industry has never been sufficiently proclaimed, and the industry's commercial activities have probably not equalled, in extent or intensity, its technical and scientific abilities For many years, German optical instruments have held a high reputation This reputation has been well deserved It has been built primarily on quality, but quality has been backed up by publicity, by advertisement, and by efficient commercial methods which, above all, rendered the selection and purchase of a suitable instrument a relatively simple matter To-day, the products of the optical glass industry and the optical instrument industry of Great Britain are well able to compete with those of any other country, and in many directions they have established a distinct supremacy

If an examination were made of similar types of optical glasses obtained through the ordinary commercial channels from British and from foreign makers, we believe that the results would show that the former are in several respects superior to the latter It is unfortunate that no detailed authoritative statement on this subject has yet been published In regard to microscopes, the best British stands have been, for long, unsurpassed, and many notable advances have recently been made in the optical parts British microscope manufacturers have now provided a series of apochromatic objectives which are superior to any made in any other country They have also introduced improvements in illuminating systems, a dark-ground illuminator having been developed which permits the use of higher powers than was hitherto possible

The superiority of British camera lenses has been frequently demonstrated Photographic lenses for aerial survey, the specification for which is particularly severe, have been supplied to foreign countries by British makers in open competition with the rest of the world The photographic lenses of aperture F/2 recently produced in Britain were the first lenses of such great rapidity, and are still distinctly the best of their class The only foreign-made lens of an equivalent speed covers about two-thirds the width of field of the British lens The telephoto lens, which originated in Britain, has been improved so as to suit the varied and extended uses to which it is now being applied, and the British lens of this type still holds a foremost place

For astronomical instruments and for instruments used in astrophysics, no country stands higher in reputation than Great Britain Since the War, British makers of surveying instruments have re-designed most of their instruments, and have effected improvements, not only in design, but also in construction and in subsequent performance The quality of the instruments is indicated by the fact that satisfactory sales are being effected abroad in the face of particularly severe competition from other countries The best British binoculars now being manufactured are a little better than the best of the same class made abroad, and in addition, binoculars have now been made here which have a larger field of view than any others at present on the market

For many years, the premier manufacturers of range-finders in the world have been British, and before the War, foreign governments were probably their best customers During these latter years, these manufacturers have continued to develop and improve their products, which for quality and efficiency are still unsurpassed

British optical instruments for physical research form another branch with a deservedly high reputation Complete equipments for dealing in a broad way with various special fields of research, such as the electron theory of matter, have been supplied by British manufacturers to laboratories in practically every country in Europe, as well as to the United States of America, Japan, and various parts of the British Empire It is probable that most of the research of the world in certain fields of prime importance in modern physics is being done with British-made instruments

On its own initiative, the optical instrument industry during the past ten years has developed apparatus for the testing of optical elements and optical instruments This apparatus, in one or other of its various forms, will measure interferometrically the errors and imperfections of any kind of optical instrument, such as, for example, an astronomical telescope, a microscope, camera lens, or binocular Photographs of the imperfections can easily be obtained, and these constitute unquestionable records The apparatus in now in use in Britain and also in certain factories and State testing institutions abroad It is thus possible for manufacturers to have applied to their lenses a test which is free from all elements of judgment, and to have the results stated in numerical measurement

Enough has been said to show that, from a technical point of view, the British optical instrument industry is active and vigorous The existence of such an industry is vitally essential to progress in science and to the healthy development of the nation Close co-operation between the scientific investigator and the optical instrument maker will facilitate a continuance of that progress and development Reference may be made in this connexion to recent investigations on filter-passing micro-organisms Adequate instrumental facilities for investigations on such organisms were not in existence a year or two ago The investigators knew the limita-

tions of their apparatus and knew what their requirements were They placed their knowledge and requirements before the instrument maker, and in a comparatively few months were supplied with the instruments which enabled them to go further and deeper into their work and to obtain those important results which have recently been published The work involved the construction of a microscope stand with an accuracy of focussing and a rigidity not provided by any existing stand, and also of an entirely novel combined illuminator, in which a high aperture dark-ground illuminator is mounted concentrically with, and encircling, a quartz condenser The former secures visibility and is used to locate the micro-organisms, while the latter is used with ultra-violet light to obtain the image on the photographic plate

Many examples could be given of the services rendered by the optician in the provision of special apparatus, often very complex and ingeniously designed, for the control of industrial processes The efficiency of the British optical instrument industry has been, to a large extent, responsible for the rapidly growing use of optical projection apparatus in connexion with industry

It is obviously in the interests of the scientific investigator, whether his work lies in the academic or in the industrial field, that there should be in the country in which he works, a progressive and efficiently equipped optical instrument-making industry Such an industry does not exist on the production of specialised instruments alone The more frequently recurring demands for instruments of the less elaborate types have also to be met The production of these provides training and experience for the members of the industry Production is regulated by demand The greater the demand for British-made optical instruments, even of the simpler type, the wider will be the field from which may be recruited the craftsmen, the artists, and the scientific designers, all of whom are required in the production of many of the masterpieces which emanate from the optician's workshop or laboratory

The contributions made by the optical instrument industry of Great Britain both to science and to industry entitle it to support and encouragement by every section of the nation During times of peaceful progress, as much as during war and strife, a prosperous and active optical instrument industry is an important national asset, the influence of which may extend far beyond mere national boundaries It should only be necessary for the users in Great Britain of optical instruments to be made fully aware of the industry's attainments and capabilities, and also of the range and quality of its productions, to ensure that such support and encouragement will not be lacking

Modern Physics

(1) *Die Methoden der theoretischen Physik* Von Felix Auerbach Pp x + 436 (Leipzig Akademische Verlagsgesellschaft m b H, 1925) 13 gold marks

(2) *Introduction to Theoretical Physics* By Prof Arthur Haas Translated from the third and fourth editions by T Verschoyle Vol I Pp xiv+331 (London, Bombay and Sydney Constable and Co, Ltd, 1924) 21*s* net

(3) *Physics a Text-book for Colleges* By Prof Oscar M Stewart Pp viii+723 (Boston and London Ginn and Co, 1924) 17*s* 6d net

(4) *Lehrbuch der Physik in elementarer Darstellung* Von Arnold Berliner Dritte Auflage Pp x+645 (Berlin Julius Springer, 1924) 18 60 gold marks

IN the older British universities the term natural philosophy is still used to denote one of the main branches of study In 1747 we find Mr David Young appointed to be "professor of natural and experimental philosophy" in the United College of St Salvator and St Leonard in the University of St Andrews In the Scottish universities, applied mathematics fell within the province of the department of natural philosophy There lies before us an M A diploma of the University of Glasgow, dated 1863, signed, amongst others, by Gul Thomson, *Phil Nat Prof* There is something to be said for retaining the more sonorous designation natural philosophy, at least for official purposes, in preference to the more compact term physics It is the science which treats of the general properties of natural bodies "The philosophy of science," says Prof Whitehead, "is the endeavour to formulate the most general character of things observed" The changes which have taken place in our outlook upon natural phenomena during the first quarter of the present century have been profound, but yet they must be described as evolutionary rather than as revolutionary in character Not only have there been brilliant experimental discoveries, resulting in entirely new methods of investigation, but also during the same period new theoretical conceptions have been introduced by Planck, Einstein, and Bohr, which have led to much questioning as to the fundamentals of our philosophy

These developments, which have been discussed in a very large number of special treatises, have tended to render many of the older text-books, if not obsolete, at least imperfect and incomplete The time has now arrived when it appears necessary to make provision for the new knowledge by revised and extended treatment The task is no easy one, partly because of the rapid accumulation of new material and partly on account of our imperfect grasp of the new theories

Another and very serious difficulty is the amount of mathematical knowledge and training required for the full appreciation of old and new theories alike. As Prof. Donnan says in his foreword to the volume by Prof. Haas:

"A sure understanding of the quantitative principles of physical science is nowadays a necessity for everybody—for the chemist, engineer, and physiologist as much as for the physicist. Nobody can afford to say that he is not a physicist and so expect to be forgiven for his ignorance." Nevertheless, the difficulty is a real enough one for the many who fear the mathematical reasoning and the wealth and subtlety of physical science."

This raises the important question of the relation between the teaching of mathematics and the teaching of physics. If, as is now the custom in most, if not all, British universities, the teaching of each subject is undertaken by a separate department, it is clearly desirable that the teacher of applied mathematics should be in sympathy with the experimental work of the science student, and if possible be himself in some sense an experimenter. To the reviewer, who has had experience of the Mathematical Tripos of former days, it seems only a truism to say that in a well-arranged university course the mathematical and experimental work should proceed side by side, acting and reacting upon each other to the mutual advantage of both.

In the Rouse Ball Lecture for 1924 Dr. Horace Lamb has emphasised the condition for mathematical progress stated by Fourier: "The profound study of Nature is the most fruitful source of mathematical discoveries." The tendency, which has unfortunately prevailed at Cambridge, to separate mathematics and physics into watertight compartments must be strenuously resisted.[1] The same may be said, in perhaps lesser degree, of other branches of science.

(1) The problem referred to above has been encountered by Dr. Auerbach, of Jena, who states that his experience proves that a student who attends without preparation courses on the special branches of theoretical physics (mechanics, heat, electricity, optics) does not appreciate the meaning of the whole or understand the methods employed in obtaining the results. On the other hand, he found that an introductory methodical course (largely concerned with mathematical processes) attracted a large number of students, who afterwards attended special courses with much greater benefit. This volume is the outcome of such a preparatory course of lectures. The author starts with the fundamental principles and then proceeds to deal systematically with the methods, passing from ordinary language to the language of mathematics, from the elementary to the more advanced, from the infinitesimal to the statistical, from the arithmetical to the geometrical. Examples illustrating the mathematical methods are drawn from all branches of physics. The resulting impression conveyed is that of a rearranged text-book of physics in which the subjects are now grouped so that each individual experiment or theoretical investigation serves as an illustration of a particular type of mathematical equation or method. Thus cubic equations are illustrated by the example of the equation of state of Van der Waals, maxima and minima by the greatest range of a projectile and the position of minimum deviation of a prism.

If the point of view taken by the author be conceded, the resulting treatise may be regarded as satisfactory, for the work has been well done and the exposition is clear. The title chosen is slightly misleading, as it does not convey to the casual reader the fact that by far the most important function of the book is to elucidate mathematical methods in their physical applications. In a book of this character dealing with complex functions, differential equations, and spherical harmonics, it is remarkable that vector methods are not introduced until page 407 is reached.

(2) In writing his text-book, Prof. Haas, of Vienna, states that his aim is to provide an exposition which, while modern in treatment and outlook, would give a survey of the present state of theoretical physics, its principles and problems, without going too far into details. On looking over the pages for the first time, it might be inferred that this was a book for the mathematical physicist. It is true that symbolic and vectorial methods are employed and the principal rules of differential and integral calculus are assumed, but let the non-mathematician take heart—he is led on by gradual stages from the more familiar to the more abstruse. Prof. Haas is a skilful teacher, and the earnest student who follows him with care should finish the volume with greatly widened knowledge and sincere appreciation of the help rendered. To quote again from the foreword by Prof. Donnan: "The whole structure of physical theory is built up piece by piece, with an exposition so sequent and crystal clear that we can pass through and understand the great luminous building without painful effort." This first volume deals with mechanics, with the general theory of vector fields, of vibrations, and of potential, and also with the theory of the electromagnetic field and of light. The important subject of atomistic physics is postponed to later volumes. In an appendix of 20 pages a convenient summary is given of the contents of Vol. I.

An eminent exponent of the principle of relativity is credited with the dark saying that the mathematician is never so happy as when he does not know

[1] See NATURE, vol. 114, p. 460, 1924.

what he is talking about! He rejoices in the breadth of his generalisations and may say with the poet

> "There are nine and sixty ways of constructing tribal lays,
> And every single one of them is right"

Perhaps! But the historian may attach very different values to them as accurate or even approximate records of tribal history It is often difficult to determine at what point in a mathematical argument some tacit assumption is made, the rejection of which would invalidate the subsequent reasoning As a rule, Prof Haas is very careful in this matter, but consider the statement on page 211 "It is *impossible* for a *single magnetic source to exist* by itself" (italics as in the original) This is said to be a fact which necessarily follows from the definition of magnetism Doubtless—if the author's definition is accepted, but should the physicist isolate a magnetic pole to-morrow, the mathematician would have no difficulty in formulating a new definition of magnetism

(3) The college text-book of physics by Prof Stewart is of a more elementary character and does not call for detailed criticism It should prove suitable for students who expect to specialise in agriculture or medicine, or for those who are taking physics as part of a general course in arts and science The author realises that there is a more important purpose than that of merely giving useful information "The great discoveries and applications of science, to which we are to-day so indebted, have been due primarily to the development and diffusion of what may be called the modern scientific method of reasoning The study of physics offers unusual opportunity for acquiring this method" Stress is laid on the importance of grasping the fundamental principles of the subject, but only after the student has had the opportunity of becoming familiar with the facts, are deductions or generalisations made The principles are illustrated by a large number of examples drawn from common experience An interesting and valuable feature is the introduction of a chapter on meteorology, "the physics of the atmosphere," with special reference to the United States and Canada The volume is well illustrated and is liberally provided with numerical problems

(4) Dr Arnold Berliner, editor of *Die Naturwissenschaften*, has faced and accomplished successfully the difficult task of revising his "Lehrbuch der Physik," which now appears in a third and enlarged edition The author acknowledges his indebtedness to Profs Geiger and Henning for assistance in dealing with the subjects of atomic physics, radioactivity, and heat The amount of information contained in these 645 quarto pages, many of them closely printed, is extraordinary The standard is about the same as that of Ganot or Deschanel, but the range is wider, and modern work is discussed from the beginning of the book As illustrating the mixture of old and new, we may note that the quantum theory of specific heat comes only six pages later than the description of Lavoisier's ice-calorimeter, a few pages further on follows a well-illustrated account of the steam turbine

The author realises clearly the restrictions imposed upon him by the elementary character of the work While this makes a certain breadth of treatment—even amounting to prolixity—inevitable, it demands many sacrifices as regards strictness of demonstration and fullness of detail The stringent claims of the professional physicist must sometimes be disregarded, and on didactic grounds only what is essential must be retained It is remarkable, however, how much can be accomplished without the employment of advanced mathematical methods Not many authors, for example, would care to face the task of presenting in some half-dozen pages an outline of both the special and the general theory of relativity It is open to question whether the author is justified in adopting the bold plan of stating the principles of thermodynamics, including Nernst's heat theorem, before giving an account of the fundamental methods of thermometry and calorimetry

British physicists are, as a rule, generously treated, and quotations are made from the writings of Faraday, Maxwell and Tyndall, but it may be pointed out that, long before Helmholtz in a celebrated memorial lecture emphasised the work of Faraday, the latter had formed a clear conception of the existence of atoms of electricity The sections dealing with the development of the electron theory deserve a special word of praise, these take up in turn the subjects of discharge in gases and the phenomena of ionisation, Rontgen radiation, radioactivity, and the structure of the atom In the last-named section a very lucid and interesting picture is given of the atomic model due to Rutherford and Bohr, together with a short account of its application to the explanation of the hydrogen spectrum The work of Moseley on X-ray spectra and that of Aston on isotopes is briefly described, and Einstein's photo-electric equation is discussed The numerous diagrams, though reproduced on a small scale, are remarkably clear and add greatly to the value of the book

Of special interest is the chronological table which fills the last three pages of the volume This contains the names of the leading natural philosophers of all nations from A D 1500 to the present time, and shows at a glance the life-period and the contemporaries of each Such a table in the form of a wall-chart would be invaluable in the lecture-room of any department of physics

H S Allen

H I

Our Climatic Environment

(1) *Civilisation and Climate* By Ellsworth Huntington Third edition, revised and rewritten, with many new chapters Pp xix+453 (New Haven Yale University Press, London Oxford University Press, 1924) 23s net

(2) *Principles of Human Geography* By Ellsworth Huntington and Sumner W Cushing (Huntington Geography Series) Third edition, revised Pp xviii+430 (New York J Wiley and Sons, Inc, London Chapman and Hall, Ltd, 1924) 15s net

(3) *Climatic Laws Ninety Generalisations with numerous Corollaries as to the Geographic Distribution of Temperature, Wind, Moisture, etc, a Summary of Climate* By Prof S S Visher Pp 96 (New York J Wiley and Sons, Inc, London Chapman and Hall, Ltd, 1924) 7s 6d net

(1) FROM archæological studies in Asia and Central America, Prof Ellsworth Huntington was convinced that at certain periods in the past the population of these regions was not only larger than at present, but also more energetic and progressive He also found evidence that in the arid parts of Asia these more populous periods were blessed with a greater rainfall Hence he developed the "pulsatory" hypothesis of climatic changes This hypothesis has met with a considerable amount of criticism, the most obvious of the alternative views being that with proper irrigation the land is still capable of supporting a large population, and that the inhabitants have to thank their idleness and improvidence, or the lack of enlightened government, for conversion of their fields into deserts It must be agreed that the present inhabitants of Mesopotamia or the Indians of Central America would provide very poor stuff on which to build up a great empire like those of antiquity Huntington has frankly admitted the point, and has turned the tables on his critics by making the variation of human efficiency with changes of climate an essential part of his theories In so doing he has achieved a great deal of useful work in what may be termed the science of "applied climatology"

The first edition of "Civilisation and Climate" appeared in 1916, and opened with a detailed analysis of the amount of work done under different climatic conditions by a number of groups of people, mainly in the United States The conclusion arrived at was that the most favourable conditions for human efficiency were a mean temperature in the neighbourhood of 60° F, a moderate seasonal range, a moderate variability of temperature from day to day, and a considerable degree of "storminess," the latter condition providing a stimulating series of weather changes The material was good so far as it went, but being based mainly on a single country within the north temperate belt, it did not seem to provide a sufficient groundwork for a discussion ranging from the tropics nearly to the poles In the third edition, the basis has been extended by a detailed discussion of the death rates in a number of large towns, in relation to daily and seasonal changes of weather

The results confirm those obtained from measurements of work done under varying conditions, but the basis is still predominantly American The mean annual temperature of the eastern United States ranges from about 50° F in the north to 70° F in the south, and the optimum temperatures for health and physical energy range from 58° F in Connecticut to 68° F in Florida For mental energy the optimum is lower, but the data are few and incomplete In the north, where buildings are warmed in winter, the average annual temperature in which people live is higher than the mean temperature of the open air, so that the conclusion can legitimately be drawn from Huntington's figures that people are healthiest and work best in the temperatures to which they are most accustomed One would like to see this part of the book extended to include the work of native races in the tropics and in the far north, but it is admitted that the necessary data would be hard to obtain The other climatic factors of efficiency, variability of temperature and weather, are not open to this objection to quite the same extent, and there seems to be no doubt that these factors are responsible for small variations of 2 or 3, perhaps 5 per cent in the output of work Whether these variations are large enough to be significant in human progress remains doubtful

On the basis of the results for temperate eastern America, the author proceeds to calculate the energy value of the climate of each part of the globe The formula employed is arbitrary, and perhaps assigns too much importance to temperature, but granting the initial assumption that the climate of New England is highly favourable, it appears to fulfil its purpose sufficiently well This map of climatic energy is compared with a map of "civilisation," according to the opinions of fifty competent authorities The agreement of the two maps is striking, and really forms the main justification for the book

The concluding chapters deal with the civilisations of antiquity, and the opinion is expressed that they grew up along the storm belt when it lay much farther south than now But in the efficiency formula the temperature terms predominate, and since these have admittedly not changed appreciably, this amounts to an assumption that the optimum temperature was also higher, in other words, that the needs of the human

species have changed since that date Hence it seems that the effects of storminess and especially of rainfall need to be considered in greater detail, and quite apart from temperature Criticisms such as these are, however, matters of detail, the book certainly succeeds in its main object, which is to bring out the importance of climate in human activity and well-being It remains only to add that it makes very interesting reading and is well illustrated, while the general appearance is excellent

(2) The "Principles of Human Geography" is a text-book dealing with the relation of man's activities to the environment in which he lives The first nine chapters deal with the more strictly geographical aspect—latitude, land-forms, bodies of water, soil, minerals and sources of power—and show how these control human life in different regions The remainder of the book deals with the influence of climate, through its effect on plants and animals and on human efficiency, according to the views of "Civilisation and Climate"

Each of the different climatic regions has its own series of plant and animal products and its especial climatic advantages and handicaps In the regions where the "climatic energy" is least, man is the slave of his environment, while in more favourable climates he begins to overcome his handicaps and improve his opportunities In this way arise a number of characteristic cultures, which are skilfully described and analysed Finally we come to the regions of cyclonic storms, the fortunate inhabitants of which rise superior to their environment, reaching out to the ends of the earth to gather the products of all countries, and to dominate their weaker neighbours, and the last few chapters may be described as the epic of "cyclonic man"

The authors have kept a restrained and lucid style throughout, while the book is well printed and illustrated Each chapter concludes with a series of interesting problems requiring independent research, and one can readily accept the authors' statement that the students tackle them with great enthusiasm and interest

(3) "Climatic Laws," unlike the two preceding books, appears to be the result, not of original thinking, but of much reading It presents ninety generalisations, which are considered to correspond with the "laws" of other sciences The idea is good, but the author's methods result in a heterogeneous mixture of dogmatic statements Some are so obvious that it does not seem necessary to commit them to writing (*e g* the "law" that days and nights vary in length in middle and high latitudes), some are not true (*e g* "There are for most places two diurnal maxima and two minima for precipitation The maxima usually are at 2–5 P M and 3–6 A M"), the remainder are useful summaries of facts The book is also marred by several examples of loose writing Its most valuable feature is the long list of references, but the author would have been well advised to quote more extensively than he has done and also to add a few pages of tables

The Tetraphyllid Cestodes

A Monograph on the Tetraphyllidea with Notes on related Cestodes By Dr T Southwell (Liverpool School of Tropical Medicine Memoir (New Series) No 2) Pp xv + 368 (Liverpool University Press of Liverpool, Ltd, London Hodder and Stoughton, Ltd, 1925) 20*s* net

THE most difficult group of helminth parasites to deal with from the morphological point of view is the Cestoda They have superficially a very considerable resemblance to each other and an elaborate technique is necessary before their internal anatomy can be satisfactorily studied The older naturalists in their classifications based their systems largely on the external characters—characters which in a colourless animal such as a tapeworm are unsatisfactory, and are rendered even more unsatisfactory by the extremely muscular nature of the parasite and the absence of any supporting skeleton to retain a permanent shape Moreover, the complicated life-cycle of these animals has made confusion worse confounded and our knowledge of the whole group is in a very chaotic condition indeed

At present four orders of Cestoda are generally recognised These are (1) the Cyclophyllidea, which contains most of the common forms from mammals and birds and on that account has had the greatest amount of attention, (2) the Pseudophyllidea, which includes the Broad tapeworm of man and has recently been the subject of a monograph by Nybelin, (3) the Trypanorhyncha, which is at present in a state of the utmost confusion, and (4) the Tetraphyllidea, which is the subject of the present able monograph To these four Dr Southwell has added a fifth and smaller order, the Heterophyllidea This new order is considered exhaustively in the present work

Dr Southwell has been engaged in the study of the cestodes of fish for about sixteen years—especially in connexion with the Ceylon Pearl Fisheries and as Director of Fisheries in India—and the present volume is the result of that research This work, supplemented by a recent paper on the Tetrarhynchids (the Tetrarhynchidæ is one of the two families composing the Trypanorhyncha) found in Ceylon Marine Fishes (*Ann Trop Med and Paras*, 1924, 18, pp 459-491), forms a complete monograph on the cestodes of fish

This volume consists of four parts, of which the first is of more general interest than the others It is devoted mostly to a critical examination of the present systems of classification of the whole group Dr Southwell believes that the five orders can only be separated naturally by means of the shape of the head Thus the Cyclophyllidea have four suckers, the Pseudophyllidea either one (rarely) or two (commonly) bothria or sucking grooves, the Tetraphyllidea have four lappet-like outgrowths from the head called bothridia, while the Trypanorhyncha have four proboscides each of which is armed with spines Forms which cannot be included in any of these four are referred to his new order, the Heterophyllidea The Cyclophyllidea he proposes dividing into two sub-orders The first of these, the Univitellata, which is equivalent to Stiles' superfamily Tænioidea, is characterised by the possession of a single unpaired vitelline gland The second sub-order, the Multivitellata, has more than one yolk-gland and contains the Proteocephalidæ and the Lecanicephalidæ of Braun While no system of classification in a subject so imperfectly known as this one can be regarded as permanent, this scheme even in the light of our present knowledge, is not fully satisfactory Where in it, for example, can we place the genus Mesocestoides? This genus consists of forms with a four-suckered head and a typical Cyclophyllidean anatomy, but the genital opening is ventral, not lateral as in most forms of this order, and there are *two* discrete vitelline glands in a posterio-median situation It does not seem to find a place in Dr Southwell's scheme It is so obviously a close relation to the Tænoid cestodes that it would seem that Dr Southwell's Univitellata will have to be modified to include it

The remaining three parts are of interest more to the specialist than to the more general zoologist or parasitologist Part ii deals with the Tetraphyllidea, part iii with the Cyclophyllidea in fish, and part iv with the Heterophyllidea These sections, which are illustrated with nearly 250 drawings, discuss in a lucid and exhaustive manner all the forms belonging to these orders found in fish Apart from the fact that future workers are now provided with modern and comprehensive accounts of these parasites, Dr Southwell has rendered a very considerable service to science by greatly reducing the number of described species

The task which Dr Southwell had set himself was one of great difficulty the result is a work highly creditable to himself and a contribution of considerable value to zoology

The volume is introduced by a very characteristic foreword by Sir Arthur Shipley, and forms the second of the series of memoirs being published by the Liverpool School of Tropical Medicine

The Internal Combustion Engine

(1) *Automobile Engines in Theory, Design, Construction, Operation, Testing and Maintenance* By Arthur W Judge (Motor Manuals a Series for all Motor Owners and Users, vol 1) Pp vii + 189 (London Chapman and Hall, Ltd, 1925) 4*s* net

(2) *The Testing of High-Speed Internal Combustion Engines with Special Reference to Automobile and Aircraft Types and to the Testing of Automobiles* By Arthur W Judge Pp xvi + 392 + 54 plates (London Chapman and Hall, Ltd, 1924) 25*s* net

(3) *Cost of Power Production by Internal Combustion Engines* By G A Burls Pp iv + 56 (London, Glasgow and Bombay Blackie and Son, Ltd, 1924) 5*s* net

(1) THERE is something to be said for the point of view that an elementary book on the internal combustion engine should really be an elementary book on the heat engine and should therefore contain an account of the steam engine in addition to those basic principles of the theory of heat which are common to both forms of prime mover But in practice some differentiation is very usual, the number of readers interested in one is so vastly greater than the number interested in the other Mr Judge's book, which appears as one of a series specially written for "all motor users and owners" is an example of this

We should at one time have expected to find a good proportion of motor owners but ill-equipped for the reading of such a book as Mr Judge's, but the intense interest taken by a very large section of the public in the technicalities of radio broadcasting shows that we must be prepared to enlarge our ideas as to the receptiveness of the general public to technical writings If this receptiveness applies now, or can be made to apply hereafter, to the study of automobile engines, Mr Judge's book should prove to have achieved its object It contains a great mass of information of the familiar type, and it presents it in a convenient and orderly form The subject-matter is brought up-to-date, for example, the methods of supercharging automobile and aero engines are described, as are also the features of the modern anti-detonation substances for admixture with ordinary engine fuel

(2) This book, also from the pen of Mr Judge, is a very complete statement of the technics of the testing of high-speed internal combustion engines In the course of its nigh on four hundred pages, the requirements of manufacturers, of inspectors and of laboratory assistants, appear equally to be met, but it is scarcely a book for general reading those, however, whose work leads them to consult it will be grateful to the author for the painstaking way in which he has

collected information dealing with every aspect of testing, whether relating to stationary engines, automobile engines, or aircraft power plant

(3) Mr Burls is well known as a capable writer on the subject of the internal combustion engine, and we received with interest his new volume on the cost of power production by these engines The period of time covered by this inquiry, as the author points out, includes that of the War, and many of the figures given are of special interest as showing the rapid increase in costs as hostilities proceeded, and the subsequent slow decline as the world gradually returned towards peaceful conditions Apart from this, there is the factor that if the interest taken in this engine is to bear fruit, it is necessary that information giving up-to-date figures of capital and working costs, particularly in comparison with other forms of power production, shall be ready to hand It is rather a shock to notice on p 44 of this new book that some of the statistics go no later in date than June 1921, although on the same page there is other information dated August 1924

An especially interesting point is made by the author when dealing with the power capacity of large gas engines He quotes Sir Dugald Clerk's view of the limiting factor in terms of heat units per cubic foot of piston displacement, and shows that this is much better expressed as a limiting mean effective pressure on the basis of a constant thermal efficiency As applied to the large gas engine, this leads to the range of 55 to 65 lb per square inch, and the author quotes 64 lb as representing current practice in 1924 This makes a bulky installation compared with that of a steam plant, and unless it were for the great difference in the average over-all thermal economy (as 15 per cent is to, say, 8 5 per cent) the internal combustion engine would come badly out of such a comparison

Mr Burl's book will be of very real use to the engineering profession

Fossil Man

Human Origins a Manual of Prehistory By Dr George Grant MacCurdy Vol 1 The Old Stone Age and the Dawn of Man and his Arts Pp xxxviii + 440 Vol 2 The New Stone Age and the Ages of Bronze and Iron Pp xvi + 516 (New York and London D Appleton and Co, 1924) 42*s* net

DURING the past thirty years Dr MacCurdy has paid frequent visits to the Old World to study on the spot the various discoveries of prehistoric man and his handiwork For some time he has also directed the American School of Prehistoric Research in Europe He has taken part in several diggings, notably in the exploration of the cave of La Combe (Dordogne) by the Peabody Museum of Yale University in 1912 He is curator of anthropology in this museum, and has had much experience in teaching Dr MacCurdy is therefore well qualified to produce a students' manual of prehistory with first-hand information, and his two handsome volumes now before us will be widely welcomed He is cautious—perhaps too cautious—in expressing opinions of his own, but his work is most exhaustive in summarising the conclusions of the authors quoted by him He has discussed the various subjects with most of these authors, and so is able to present them to the student in the most satisfactory manner

The first volume begins with a useful glossary, and the second ends with tables of the stratigraphy of palæolithic sites, a repertory of palæolithic art, and a list of the prehistoric monuments of France Numerous authoritative synoptic tables, besides bibliographies, are also scattered through the text Dr MacCurdy has thus provided not only a readable story, with excellent illustrations, but also a work of reference of the greatest value

After a brief history of the development of prehistoric chronology, there is the usual attempt to correlate the successive races of palæolithic man with the various phases of the ice age which are recognised in the Alps Late glacial and postglacial time is measured by discoveries in the geology of Scandinavia The extent of the ice-sheet at the successive periods is shown in a new map which has been compiled from many sources The handiwork of eolithic and palæolithic man is then treated in several chapters, which are illustrated by photographs of sites taken by the author and by numerous new figures of stone implements in the Yale University collection Finally, the known remains of the skeleton of palæolithic man are briefly described, with numerous illustrations Dr MacCurdy is careful to emphasise the doubts about several specimens of which the antiquity is very uncertain, and he emphatically rejects the discoveries of Ameghino in South America

A whole chapter is devoted to the Azilian and other stages which belong to the interval between the palæolithic and neolithic periods Their wide geographical distribution seems surprising when they are tabulated on Dr MacCurdy's plan The neolithic period is then concisely treated from every point of view, concluding with an account of the megalithic monuments There is, however, no allusion to the temples in Malta which have been described as of neolithic age Fire, hunting, fishing, navigation, the wheel, the domestication of animals and plants, commerce, healing, and magic or religion during the stone

age are then considered in general, and the work concludes with some account of the ages of bronze and iron

Among the numerous treatises on prehistoric man which have appeared during recent years, the new one of Dr MacCurdy is assured of a high place, and we cordially recommend it to the notice of all serious students A S W

Our Bookshelf

University of London Francis Galton Laboratory for National Eugenics Eugenics Laboratory Memoirs, 22 The Treasury of Human Inheritance Edited by Karl Pearson Vol 3 *Hereditary Disorders of Bone Development* Part 1 Diaphysial Aclasis (Multiple Exostoses), Multiple Enchondromata, Cleido-Cranial Dysostosis, by Dr Percy Stocks, with the Assistance of Amy Barrington Pp vi+182+16 plates (Cambridge At the University Press, 1925) 45*s* net

OF the twenty-two valuable memoirs issued by the Francis Galton Laboratory for National Eugenics, eight form part of the "Treasury of Human Inheritance" These Treasury memoirs deal exhaustively with inborn anomalies, disorders of growth or pathological conditions, all of which may pass from parent to offspring and therefore afford opportunities of studying the laws of heredity as they affect man Former memoirs have been devoted to anomalies of the foot and hand, to cleft palate, hare-lip, deaf-mutism, imperfect differentiation of sex, hæmophilia, dwarfism and anomalies of the eye, the memoir under notice, the eighth of the Treasury series, deals with those disorders in the growth of bones known to medical men under the names of *Diaphysial aclasis* (multiple exostoses) and *Cleido-cranial dysostosis*

The present memoir, for which Dr Percy Stocks is mainly responsible, maintains the high standard set by former numbers of the series, it will remain for many a day the source from which students and experts must draw information concerning some of the most obscure disorders which overtake the bones of growing children Diaphysial aclasis affects chiefly the growing ends of the long bones Dr Stocks has found 976 cases of this disorder in medical literature, 183 families gave rise to 765 cases, there was evidence of heredity in 69 6 per cent of the cases tabulated Transmission is stronger through the male than through the female Another, but rarer, disorder of growing bones is also dealt with, namely, multiple enchondromata, which may be associated with diaphysial aclasis, and is certainly related to it in nature In the condition known as cleido-cranial dysostosis there is a partial failure in the formation of the clavicle, and with this there is usually associated an irregular formation of the vault of the skull Records of 144 cases of this disorder have been collected, the condition was familial in 96 instances

Prof Karl Pearson is rendering a most valuable service to all students of the human body by securing the preparation and publication of these memoirs, and it would be a thousand pities if the series were to come to a premature end for lack of public support

Handbuch der Zoologie eine Naturgeschichte der Stamme des Tierreiches Begrundet von Prof Dr Willy Kukenthal Herausgegeben von Dr Thilo Krumbach Erster Band Protozoa, Porifera, Coelenterata, Mesozoa Vierte Lieferung Pp 513-608 5 40 gold marks Funfte Lieferung Pp 609-736 7 20 gold marks (Berlin und Leipzig Walter de Gruyter und Co, 1925)

THE greater part (pp 522-686) of these two sections of the Handbuch is devoted to an account of the Scyphozoa contributed by Prof T Krumbach, of Berlin He defines the class and gives a short history of the Scyphozoa, in the concluding paragraph of which he refers to the *Tessera princeps* of Haeckel and remarks that this owed its existence to Haeckel's need for a primitive form which, however, never existed in life The *Tesserantha connectens* of Haeckel is a larval form of the imperfectly known rhizostome Leonura, and a similar larval form is known in the genus Cassiopea The author describes each of the five orders of Scyphozoa, beginning with the Lucernariida and ending with the Rhizostomeæ, giving under each a definition, a short history, the characters of the principal genera illustrated by schematic diagrams, accounts of the morphology, development, and physiology, references to recorded abnormalities, and brief discussions of the ecology, geographical distribution (with maps), and phylogeny Appended to each section is a useful bibliography of the order

Under the order Coronata is an excellent account of the strange genus Tetraplatia, but the author is careful to point out that there is not sufficient evidence to establish the relationships of this genus

This is an admirable memoir on the structure, biology, and physiology of the Scyphozoa, and the author is to be congratulated on having brought it, including the references to published works, so well up-to-date—the MS was closed on December 28, 1924 While the account is well illustrated, there are lacking a few figures which would have been helpful to the reader, *e g* of the remarkable tentaculocysts of Charybdea and the tentaculocyst of the adult Aurelia

The remainder of the fifth Lieferung contains a portion of the description of the Octocorallia by the late Prof W Kukenthal—one of the outstanding authorities on this sub-class—and he has given a worthy account of the orders Alcyonaria (Alcyonacea) and Gorgonaria (Gorgonacea)

The Subject Index to Periodicals, 1921 Issued by the Library Association K Science and Technology Pp 126 (London Grafton and Co, 1924) 21*s* net

THE Library Association has issued a new instalment of its valuable Subject Index to the periodical literature of science and technology The section covers the literature published in 1921 but contains some papers of earlier date There are about 6000 entries obtained from the examination of 290 periodicals

The periodicals selected are, for the most part, those printed in the English language, being published in the British Empire or in the United States of America We notice, however, that titles in French and German have been taken from the following periodicals *Bulletin de la Société pour l'Encouragement de l'Industrie nationale, Revue des Deux Mondes, Scientia, Journal*

Économique, Chemiker-Zeitung, Physikalische Zeitschrift, Sitzungsberichte der Preussischen Akademie, Forschungsarbeiten des Ingenieurwesens, Gewerbefleiss, Zeitschrift des Vereins der Ingenieure, Zeitschrift für historische Waffenkunde, Preussisches Lehrbuch, Zeitschrift für Reproduktionstechnik, and *Veröffentlichungen des Militär-Sanitätswesens*. This list of foreign periodicals consulted is taken from the first half only of the index which extends to 252 columns, and must not be taken as exhaustive, but it does suggest the question as to whether the Library Association could not see its way to include a greater number of foreign papers in its subject indexes.

The range of subjects catalogued in this section is so wide that any one interested in science will find his own branch of study dealt with under many of the headings, which are arranged in alphabetical order. A few such headings may be quoted as examples: Aeronautics, airships, alloys, aluminium, artillery, atoms, petroleum, relativity, ship propulsion, spectrum, wireless telephones, thermionic valves, vitamins, and parasitic worms. It would be impossible to include every scientific paper published in 1921 without making the list too bulky and too expensive for ordinary subscribers, so that a selection has had to be made.

It will be evident that the compilers of this index must have had great difficulty in deciding what papers should be included and which excluded. We think they have exercised a wise judgment in their selection.

Studies in Ampullaria. By E. G. Alderson. Pp. xx+102+19 plates. (Cambridge: W. Heffer and Sons, Ltd.; London: Simpkin, Marshall and Co., Ltd., 1925.) 21*s.* net.

THE scope of the work under notice is not what the author originally intended it should be. He had hoped to produce a complete monograph of the genus, but the necessary material could not be got together and Mr. Alderson has unfortunately made use solely of shells in his own possession. This is a very great pity, for the subject even thus restricted has been so ably handled that the wider work would have been warmly welcomed by conchologists—we cannot say malacologists, since all allusions to anatomy and ecology are rigidly excluded.

The author candidly admits that Bolten's name of Pila for the genus, or at all events a section thereof, has priority over Lamarck's, and so by the Rules for Zoological Nomenclature should be employed, but seeks to justify his preference by the stale excuse that Ampullaria is the more familiar name; thus he misses his chance of assisting in forwarding the cause of uniformity in nomenclature in the sole way in which it can be attained.

The work opens with a full and carefully compiled "Critical Bibliography," which in itself is of great value, but by a strange oversight omits Dall's important proposed classification published in 1904, although one of Dall's names is incidentally referred to later on. Then, after a brief "Introduction," the systematic descriptions of the species follow, each accompanied by a synonymy which seems to have been very thoroughly worked out. Any shortcomings that there may be in a work of this technical character will only reveal themselves to the student who uses it. The nineteen plates of figures, reproduced by half-tone process from the author's own drawings, are exceedingly good: they are plain, but a limited edition of fifteen coloured copies is announced. The printing and general appearance of the book are admirable.

The Platinum Metals. By Ernest A. Smith. (Pitman's Common Commodities and Industries Series.) Pp. xii+123. (London: Sir Isaac Pitman and Sons, Ltd., 1925.) 3*s.* net.

MR. ERNEST A. SMITH has produced a useful little work upon platinum and the metals associated with it, though it must be admitted that the latter receive but little, most people will probably say too little, attention. Some of them, such as iridium and palladium, deserve considerably more consideration than the book before us has given to them. Upon the whole the work may be described as accurate, although the author has not availed himself so fully as he might have done of previously published and readily available information. For example, his description of methods used in the Urals for working and washing the platiniferous gravels shows a good many omissions, which a more careful study of existing literature would have avoided.

Interest in platinum has been stimulated greatly within the last few years by the sensational discoveries in the Transvaal, though it cannot be said that the economic importance of these is even now at all known. Mr. Smith's book was written in 1924, and it is therefore no fault of his that it contains nothing more than a casual reference to the occurrence of platinum in the veins in the Waterberg district of the Transvaal. It was only towards the end of 1924 that the discoveries, possibly likely to be fraught with much greater importance, of the occurrence of platinum in the western part of the Lydenburg district were made, and these have only been quite recently described, as for example in two important papers by Dr. P. A. Wagner in the Transactions of the Geological Society of South Africa for 1925, and the *South African Journal of Industries* 1925, respectively. This fact, however, only affords one more illustration of the difficulty of writing any book on a technical subject which shall not be, in some respects at any rate, out-of-date before it issues from the press.

Board of Education. Catalogue of the Collections in the Science Museum, South Kensington; with Descriptive and Historical Notes and Illustrations. (1) Water Transport. 2: Steam Ships of War. Compiled by G. L. Overton. Pp. 102+8 plates. (2) Land Transport. 2: Mechanical Road Vehicles. Compiled by E. A. Forward. Pp. 87+10 plates. (London: H.M. Stationery Office, 1925.) 1*s.* net each.

(1) THERE are four considerable collections of warship models in London, those at the Imperial War Museum, at Greenwich, at the Science Museum, and at the Royal United Service Institution. The largest and most important is, however, that at the Science Museum. This collection had its birth when the Admiralty in 1864 sent to South Kensington a number of models for the use of the students of the Royal School of Naval Architecture, for though most of these were afterwards transferred to the Royal Naval College, Greenwich, a nucleus remained, and this has been developed from time to time. Of the sailing men-of-war, a catalogue

was issued a year ago, and the catalogue of the steam men-of-war deals with the second part of the naval collections Compiled by Mr G L Overton, the catalogue shows signs of great care, its illustrations are good, while the historical notes, though brief, are excellent summaries of the progress of warship evolution down to the *Hood*

(2) The second catalogue under notice deals with the second group of the Land Transport Section of the Museum—mechanical road vehicles We here meet with the steam carriages of Cugnot, Murdoch, Trevithick, Gurney, and others, as well as the petrol cars of Benz, Panhard, Daimler, and Rolls-Royce The motor section often has up-to-date bicycles, engines, etc, on loan, but these do not appear in the catalogue Many of the early historic petrol cars in the possession of the Museum are still stored in the basement

Biochemistry a Laboratory Course for Medical Students By I Frost Pp 11+56 (Madras Government Press, 1924) Not for sale

THE multiplication of manuals dealing with practical biochemistry for medical students appears to be an expression of the differences existing between the courses in this subject in the various schools Each teacher selects from the large number of possible exercises those which both fulfil the requirements of the examination his students must pass and at the same time appear to him most suitable Each school thus tends to develop its own course in biochemistry, with the result that a course which reaches publication as a small manual may fail to meet the requirements of other schools, which are, however, induced by its appearance to publish their own course

The manual before us appears to us to strike a distinctly original note, Dr Frost has apparently kept in mind the fact that biochemical investigations nowadays come to the aid of the clinician, and that an acquaintance with the methods used in the laboratory is essential for a true evaluation of the results of these investigations in relation to the clinical findings The book opens with some experiments on colloids, together with examples of the colorimetric estimation of the hydrogen ion concentration of solutions the proteins and blood pigments are only briefly treated, but a selection of the modern methods used in the examination of the blood and urine is given, each method being fully described

We have noted a few misprints, especially on p 24, where some decimal points have gone astray Our impression is that the book sets a high standard in biochemistry for the medical student who is not reading for a science degree also

An Introduction to the Strowger System of Automatic Telephony By H H Harrison Pp vii+146 (London Longmans, Green and Co, 1924) 7s 6d net

IT is not very generally known that the engineers of the British Post Office have begun to change the telephone system of London into a fully automatic one The task is enormous and it will be fifteen years before it is completed During part of this time the system will be partly manual and partly automatic, but satisfactory arrangements have now been made so that this will cause no inconvenience This book is therefore very timely It deals exclusively with the Strowger system, which is the one adopted by the Post Office In this system there is a dial with 10 finger-holes punched in it If a subscriber wants to call up Gerrard 8830 for example, he has to perform seven operations He first puts his finger in the digit-hole with a G in it and moves it round to the stop and lets it go He then repeats the operation with E and R the second and third letters in Gerrard, this connects him to the exchange He then performs the same operation in the digit-holes marked 8-8-3-0 respectively This calls up the subscribers If the line is engaged the usual engaged signal is heard The causes of delay at present are mainly due to indistinct articulation and to congestion of traffic during the "busy hour" Automatic telephony eliminates the former hindrance and diminishes the latter As the change-over is effected, the number of telephone girls will be gradually diminished, the exchanges being entirely automatic, but the number of engineers and workmen required will be increased This book will make a good text-book for class instruction on automatic telephony

Switchgear for Electric Power Control By E Basil Wedmore and Henry Trencham Pp xii+335 (London Oxford University Press, 1924) 25s net

THE electric power engineer will find much in this book that will be of value to him As electrical stations increase in size, the amount and the cost of the requisite switchgear increase very rapidly Devices are required for protecting the machines and for protecting the distributing mains The question often arises whether it is worth while to instal a very expensive protection device in order to protect a main, thus paying a heavy annual insurance, or to run the small risk of having the main broken down Cable manufacturers naturally favour the latter alternative, whilst manufacturers of protective switchgear favour the former The authors rightly point out that the psychological device of calling a piece of apparatus a "lightning arrester" alone ensures a market for it, even without the accompaniment of a "publicity campaign" Many English engineers have had the temerity not to use them It has to be remembered, however, that in Great Britain we rarely have severe thunderstorms The British Electrical and Allied Industries Research Association is carrying out valuable researches on switchgear, and Mr Wedmore's official work keeps him in close touch with the most modern developments The book discusses the latest practice

Elements of Statistics By Prof F C Kent Pp xi+178 (New York McGraw-Hill Book Co, Inc, London McGraw-Hill Publishing Co, Ltd, 1924) 10s net

Is it possible to present the elements of statistics in an intelligible form to students almost devoid of mathematical training? The present volume professes to accomplish this, but it does so, if at all, only by an enormous restriction of the scope and depth of the subject Mere tabulation and pictorial representation of statistics will not in themselves suffice in general unless accompanied by a searching scrutiny of the data,

not merely by applying formulæ to them but also in the light of the principles of the theory of error and of correlation In the present volume, when a formula is required, it is usually either quoted without proof and used for numerical computation or deduced from one already quoted, but surely the results of such a computation can be appreciated only when examined in relation to the basic assumptions made in deducing the formula Within the narrow limitations the author has imposed upon himself, the treatment is good and the exposition clear The book is excellently produced

Pathologie du sympathique Essai d'anatomo-physico-pathologie clinique Par Prof Maxime Laignel-Lavastine Pp v + 1080 (Paris Felix Alcan, 1924) 90 francs

THIS volume is an exhaustive thesis dealing with the anatomy, physiology, and clinical aspects of the sympathetic system Few details are omitted from this ponderous work, indeed, the fault lies in the enthusiasm which tends to implicate the sympathetic system in many conditions of obscure origin Thus few will agree with the author in associating glaucoma, purpura, and osteodystrophies with sympathetic disturbances In many instances the evidence in favour of autonomic nervous origin is not sufficiently dealt with, for example, in the section concerning gastric crises in tabes, the rôle played by the vagus is briefly dismissed, and the possibility of "vagal crises" as an entity is not mentioned It is a pity that such an exhaustive work should have just preceded the valuable contributions of Hunter and Royle, their work on the sympathetic innervation of striped muscle and on treatment by ramisectomy is of course not included The volume concludes with a very full bibliography

Les edifices physico-chimiques Par Dr Achalme Tome 3 La molecule minerale Pp 350 (Paris Payot et Cie, 1924) 20 francs

THE principal feature of this book is a series of elaborate diagrams, first of the structure of *atoms*, which are represented as aggregates of spheres of various patterns, and then of *molecules*, which are represented as aggregates of these aggregates The author has thus succeeded in building up a very elaborate series of molecular models, but as the details of these are purely speculative, they are not of any value as an aid to the study of chemistry On the contrary, the author's system appears to call for a draughtsman to express even the simplest formulæ, and equations which can be written down in a few seconds in ordinary symbols become as complicated as the design of a new pattern for a carpet It is difficult to see what can follow from such a system except to create a mistaken impression of the complexity of chemical science

Organisation of Vocational Guidance a Companion Volume to Administration of Vocational Education By Arthur F Payne Pp xvi+438 (New York McGraw-Hill Book Co, Inc, London McGraw-Hill Publishing Co, Ltd, 1925) 17s 6d net

ALTHOUGH the subject of vocational guidance is as yet in the experimental stage, the literature connected with some of its many aspects is increasing at a very rapid rate—evidence at least of a fairly general interest in it

This book gives a survey of the chief work done up to the present time and is intended to be of use to all those responsible for advising people about their work in life, and for managers in stores, factories, and workshops It discusses the various systems of testing intelligence and special aptitudes, normal and abnormal behaviour, physical stigmata, job analysis, as well as the organisation of a vocational guidance bureau There is a useful bibliography and a large number of charts, it will be a valuable book of reference

School Geography a Critical Survey of Present Day Teaching Methods By E J G Bradford Pp 104 (London Ernest Benn, Ltd, 1925) 7s 6d net

GEOGRAPHY as taught in schools at the present day shows great advances compared with a generation ago, but Mr Bradford concludes from a wide experience of teachers and teaching that the tendency is to lay too excessive stress on causal connexions This results in incoherence and a failure of the pupils to visualise world conditions While deprecating any return to the mere iteration of facts which of old was the whole content of the subject, he pleads for the need of dwelling on other than causal relationships, especially more insistence on location and quantity In short, he wants to give more precision and coherence to school geography, and this he believes would increase its educational value The book is a thoughtful contribution to a difficult problem

Low Temperature Distillation Home Oil Supply and the Utilisation of "Waste" Coal By Sydney H North and J B Garbe (The Specialists' Series) Pp vii+216 (London Sir Isaac Pitman and Sons, Ltd, 1925) 15s net

THE authors give a reasoned and critical account of the various processes used in the low-temperature distillation of coal The problem is one of very great importance, and although authorities differ in their estimates of the usefulness and economics of the method, it is certain to attract an increasing share of attention The present volume may be welcomed as a useful contribution to the literature of the subject It is well illustrated

Agitating, Stirring and Kneading Machinery By Hartland Seymour (Chemical Engineering Library Second Series) Pp 139 (London Ernest Benn, Ltd, 1925) 6s net

THE various types of machinery used for mixing liquids and solids are described, but theory has been omitted, "in the belief that this method of treatment will be of more service to the practical chemical engineer" A little theory would perhaps have been found interesting by the general scientific reader, who must feel that the book lies outside his province It should be useful to those to whom it is addressed, and is well illustrated

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ERRATUM—By a most regrettable oversight, the notice of the volume "The Atmosphere and its Story," by Ernest Frith, and that of "Why the Weather?" by Dr Charles Franklin Brooks, were transposed That appearing in NATURE of August 8, p 204, refers to Dr Brooks' book, while the notice in the issue of August 15, p 241, should have appeared under the bibliographic details of Mr Frith's book

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE *No notice is taken of anonymous communications*]

The Nature of Radiation

BOTHE and Geiger have recently performed an experiment on the Compton effect (*Die Naturwissenschaften*, 13, p 440, May 15, 1925, *Zs f Phys*, 32, p 639, 1925) indicating that the recoil electron, and the photoelectron emitted by the scattered radiation appear simultaneously Prof A H Compton has made another experiment (Proc Nat Acad Sci 11, p 303, 1925), showing that the direction in which the scattered radiation acts in producing ionisation and the direction of the recoil electron, are related The natural interpretation of these experiments is in terms of a corpuscular theory of radiation, in which a corpuscular quantum, glancing off a scattering atom with emission of a recoil electron, very soon hits another atom and emits a photoelectron This contradicts the suggestion, discussed by Bohr Kramers, and the writer (*Phil Mag*, 47, p 785, 1924), that there was a virtual field, like the ordinary fields of optical theory, emitted during the stationary states of the atom, the function of which was to induce a probability of transition, for on that view the probabilities of ejection of electrons by the scattering and absorbing atoms would be independent, both being induced by a radiation field existing continuously, and the two electrons would be in general ejected at different times and in unrelated directions I wish to point out, however, that a corpuscular theory still is not in conflict with the main part of the idea of virtual fields

The possibility of harmony between a virtual radiation field and a corpuscular structure of light was discussed with great penetration by Prof Swann, in his address at the meeting of the American Association for the Advancement of Science last Christmas (*Science*, 61 p 425, 1925) Prof Swann suggested the existence of a field, obeying Maxwell's equations, the function of which should be to guide corpuscular quanta which might travel along Poynting s vector This was also the idea on which the writer was working when he first considered a field emitted during the stationary states, although Prof Swann was not aware of this (NATURE, 113, p 307, 1924, *Phys Rev*, 25 p 397 1925)

The theory in this form was developed in England under the guidance of Mr R H Fowler, to whom my sincerest thanks are due The essential feature was the emission of the field before the ejection of the corpuscle, that is, during the stationary state before the transition By this device were avoided the difficulties of explaining coherence, of the "size of quanta," of the presence of interference phenomena in weak light When this view was presented to Prof Bohr and Dr Kramers, they pointed out that the advantages of this essential feature would be kept, although rejecting the corpuscular theory, by using the field to induce a probability of transition rather than by guiding corpuscular quanta On reflection, it appeared that no phenomena at that time known demanded the existence of corpuscles Under their suggestion, I became persuaded that the simplicity of mechanism obtained by rejecting a corpuscular theory more than made up for the loss involved in discarding conservation of energy and rational causation, and the paper already quoted was written The changes made in adopting this view were thus not fundamental, it might be mentioned that they were not new, the failure of conservation having been suggested by D L Webster and others, and the idea of a field to induce a probability of transition being due to Jeans

The present experiments, however, seem to show definitely the characteristic properties of corpuscles the localisation of the active power of a light wave in space (Compton) and in time (Bothe and Geiger), although of course the evidence is as yet meagre The simplest solution of the radiation problem then seems to be to return to the view of a virtual field to guide corpuscular quanta One slight difficulty in the way of carrying this out should be mentioned the velocity of a corpuscle should transform under the Lorentz transformation as a velocity and Poynting s vector does not so transform There are other difficulties as well, but one may hope that none of them are insurmountable

It seems to me of particular value to realise that the facts of optics are, in general, satisfactorily described by theories of the electromagnetic field, that it is highly improbable that any essentially different theory could also explain such an extended set of facts, and that consequently we must expect to find this theory appearing in some form or other in our final description of radiation, whatever that may be, and whether it include corpuscular quanta or not Some physicists have been tempted to throw away the great work of Maxwell and Lorentz, because there are phenomena which suggest light corpuscles This seems to me a very doubtful policy for a corpuscular theory of the kind now indicated would by no means take the place of the electromagnetic theory, but would rather supplement and extend it Some of the material for this extension must naturally come from such experiments as those of Bothe and Geiger and of Compton

J C SLATER

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July 25

The Effect of Diluents on the Initial Stages of Catalytic Action

IT has been long known that the presence of diluent vapours in the reactants depresses the reaction velocity at a catalyst surface The following quantitative treatment has been confirmed by experiments on the effect of water vapour on the initial stages of the dehydrogenation of alcohol by copper Let p = the fractional partial pressure of the reactant A hence $1-p$ = the fractional partial pressure of the diluent B Then the rate at which the reactant molecules arrive at the surface is proportional to $p/\sqrt{2\pi MRT} = \mu_A p$, say Thus the probability that a reactant molecule should bombard a given portion of a catalyst at a given instant is

$$\frac{\mu_A p}{\mu_A p + \mu_B(1-p)}$$

i e the fraction of A molecules in the impinging stream of A and B molecules According to the conception of Langmuir and Frenkel, a molecule that hits another adsorbed molecule is immediately reflected, whereas when it strikes the bare surface it remains for the short period of time τ It is also known that chemical action occurs on definite centres on the catalyst surface

Let n be the number of times one of these centres becomes momentarily vacant in t units of time, then $\mu_A\ p\ n/\{\mu_A p + \mu_B(1-p)\}$ molecules of the reactant are adsorbed, and they occupy the centre of activity for a fraction of the total time $= \mu_A \tau_A p n/\{\mu_A p + \mu_B(1-p)\}$

Similarly for species *B* If the surface is saturated, the time during which a centre is left vacant is negligible compared with the time it is covered, and

$$t=\frac{\mu_A\tau_A p n+\mu_B\tau_B(1-p)n}{\mu_A p+\mu_B(1-p)}$$

Thus the fraction of the total time the centre of activity is occupied by the reactant is

$$\frac{\mu_A\tau_A p}{\mu_B\tau_B(1-p)+\mu_A\tau_A p}=v,$$

and is the fractional reduction in the reaction velocity Thus

$$1/v=(1-\lambda)+\lambda/p, \qquad (1)$$

where $\lambda=\sqrt{\frac{M_A}{M_B}}\,\frac{\tau_B}{\tau_A}$ and M_A represents the molecular weight, and τ_A the mean life of the molecule *A* on the surface This formula may be written

$$(1-v)/v=\frac{\tau_B}{\tau_A}\;\frac{\mu_B(1-p)}{\mu_A p},$$

and the fraction $(1-v)/v$ is the ratio of the number of molecules of *B* to the number of molecules of *A* present on the surface $\mu_B(1-p)/\mu_A\;p$ is the ratio of the number of molecules of *B* to *A* bombarding the surface $=n_B/n_A$ Thus if n_B/n_A be multiplied by the ratio of the mean lives of molecules *B* to *A* on the surface, we obtain the composition of the adsorbed gas film for saturated surfaces The composition of the adsorbed gas film in equilibrium with a mixture of gases *A* and *B* is given by

$$\frac{x_A}{x_A+x_B}=\frac{1}{1+\sqrt{\frac{M_A}{M_B}\,\frac{\tau_B}{\tau_A}\,\frac{p_B}{p_A}}} \qquad (2)$$

These formulæ have been verified for partial pressures of alcohol in water varying from 0 02 to 1 00 times the total pressure

Fractional Reaction Velocity observed v	Calculated from $1/v=0\ 64+0\ 36/p$	Fractional partial Pressure of Alcohol in Alcohol Water Mixtures $=p$
1 00	1 00	1 00
0 94	0 92	0 80
0 83	0 81	0 60
0 60	0 65	0 40
0 40	0 41	0 20
0 22	0 24	0 10
0 10	0 13	0 05
0 05	0 05	0 02

The agreement between the observed and calculated values is within the limits of experimental error

The apparatus with which these measurements were made has already been described (Proc Camb Phil Soc , vol 22, pp 738-50) and is very convenient for obtaining the wide variations in partial pressure necessary

F H CONSTABLE

St John's College,
Cambridge, July 30

On the Origin of Species in Flowering Plants

THE origin of species is the origin of the difference between two species The existence of a peculiar difference between good species, which does not exist between varieties, has long been realised by systematists and others This essential difference expresses itself, in part, in flowering plants, in the abortion of pollen and ovules in the hybrids, which springs, in typical cases (*a*) from a different distribution of genes between two or more chromosome pairs , so that vital genes are omitted after the reduction division in some or all of the groups of chromosomes of the F_1 of the cross An example of this is probably afforded by the crosses of certain species of Stizolobium (Mucuna) (*Zeitsch f ind Abst u Vererb* , pp 303-342, 1914), two non-homologous chromosomes appearing to have interchanged genes in one of the species In the second case (*b*) the attraction between chromosomes which should be homologous fails in the reduction divisions of the F_1 plant, so that non-conjunction (*Journal of Genetics*, 1925) takes place with regard to one or more pairs Thus there is an absence of vital chromosomes or the presence of extra chromosomes in some of the pollen and ovules This is illustrated by the two cannas " Austria " and " Italia," which belong no doubt, as their history states, to the F_1 of species crosses In " Austria," for example, the 18 single chromosomes show only 1-3 pairs at the reduction divisions All the other chromosomes segregate at random, so that no more than one pollen-grain or embryo-sac out of thousands contains only the 9 chromosomes from one parent, and survives In the cross of radish and cabbage, as Karpechenko (*Journal of Genetics*, vol 14, pp 375-396, 1924) has lately shown chromosome conjugation is absent This has also been shown in certain Digitalis crosses

Hence the origin of species is effected, *inter alia*, by (*a*) segmental interchange between non-homologous chromosomes, of which some evidence has lately been gathered in Datura, and (*b*) by the loss of attraction between chromosomes which were homologous, producing non-conjunction (*Journal of Genetics*, 1925) The hypothesis of the origin of species from crosses between species in a genus posits the existence of allied species, and can thus only be applicable in more or less exceptional cases

The species listed in any genus may consist of forms each showing one or more of the following differences from the nearest allied species

(1) Mendelian differences in one or more pairs of genes ,

(2) Mendelian or other differences permanently sustained by propagation by apogamy ,

(3) Shifting of some genes in one species between two or more non-homologous chromosomes ,

(4) Loss of mutual attraction between two or more corresponding chromosomes in the two species ,

(5) Different chromosome numbers or sizes

Of course the mere possibility or impossibility of securing an F_1 between two species may often be due to other more superficial causes than these fundamental differences

JOHN BELLING

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The Structure of Benzene and Cyclohexane and their Optical Anisotropy

IN a recent paper (Roy Soc Proc , A, vol 107, p 684), I have shown that the optical anisotropy of the gaseous molecules of a number of di-atomic and tri-atomic compounds which is evidenced by the polarisation of the light scattered from them, can be explained by the mutual action of the electrical doublets induced in the different atoms of the molecule by the electric field of the incident radiation Each atom was assumed to behave isotropically Satisfactory agreement was obtained between the observed and calculated values of the depolarisation of the scattered light in the case of the molecules CO_2, N_2O and CS_2

The investigation has now been extended to the organic molecules benzene and cyclohexane Experiment shows that the depolarisation (*i e* the ratio of the weak component to the strong) of the light scattered in a direction perpendicular to the incident beam in benzene vapour is 0 067 Assuming that the six carbon atoms in benzene are arranged in a puckered ring as in diamond, with the distance between two neighbouring carbon atoms of 1 5 Å U, and that the hydrogen atoms are joined to the carbons at the tetrahedral angle at a distance of 1 42 Å U (the sum of the "radius" of a carbon atom and half the distance between the optical centres in a hydrogen molecule as calculated from its optical anisotropy), and assuming that the refractivities of the hydrogen and carbon atoms are those appropriate to the respective atoms in the hydrogen molecule and in diamond, the anisotropy comes out to be 2 63 2 63 1 This gives a value of 0 074 for the depolarisation of the transversely scattered light

If the atoms are assumed to lie in a plane with the carbon atoms arranged as in a graphite ring, the depolarisation comes out to be 0 10 Even in the absence of the hydrogens, the six carbon atoms alone would in this case give rise to a depolarisation of 0 083 If therefore, we are to retain the plane structure for benzene, it will be necessary to assume that the polarisation of the carbon atoms when the field is perpendicular to the plane of the ring is greater than that when it is parallel to the plane of the ring

Cyclohexane vapour at pressures less than one atmosphere shows a depolarisation of only 1 1 per cent This small value is what should be expected from the known structure of cyclohexane The six extra hydrogen atoms place themselves on opposite sides of the mean plane of the carbon atoms on either side alternately, and the mutual action of the induced doublets causes the average polarisation parallel to the mean plane of the carbon atoms to be diminished while the polarisation perpendicular to the plane is increased, both contributing to a diminution of anisotropy Calculation on the same lines shows the depolarisation to be expected to be 0 8 per cent

K R RAMANATHAN

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July 18

Magnetic Conditions in Tube Railways

THOSE who have occasion to make frequent use of the tube railways in London can minimise the monotony of such journeys by taking with them a small pocket compass

Using one day a pocket compass to determine whether my hurried choice of a train was indeed taking me in the westerly direction I desired, I was astonished to find that this old and valued guide was of two minds, if no more, as to where magnetic north really lay As the train proceeded, the compass needle oscillated, made a sudden 180° turn and pointed south, and in a few moments reversed its direction again

Repeated observations show the needle to be scarcely ever steady, and this makes it difficult to distinguish the acceleration effect which must be present such accelerations when nearly at right angles to the magnetic meridian should produce an angular motion of the needle equal to the angle of change of the 'apparent vertical" multiplied by the tangent of the angle of dip I have noticed motions of the right sense and of about the right amount, but it has not been possible to compare the amount of the accelerations so indicated with those determined by other methods

I do not know whether any one else has noticed the complex magnetic condition of tube railways, but I do know that any visitor who relies for directional advice upon a pocket compass may be led sadly astray

H E WIMPERIS

August 4

Fine Structure of Optically Excited Spectrum Lines

IN the course of investigations on the optical excitation of gases in this laboratory, we noticed the interesting fact that the spectrum lines emitted by mercury vapour illuminated by an intense mercury lamp have a much simpler fine structure than usually For example, the green line 5461, the complexity of which under ordinary conditions is well known, presents no components besides the central line, which when viewed through a 30 cm Lummer plate, is resolved in 3 components only The violet line 4359 exhibits the same features, the intensity of the stronger satellites as compared with that of the central line being very much less than in the arc The same seems also to be true for the yellow line 5770 On the other hand, the lines 4047 and 5791 show all the strong satellites

This absence of some of the satellites which are intense in the arc affords an argument in favour of the view that these are not due to isotopy

E GROSS
A TERENIN

Optical Institute,
Leningrad,
June

Science and Intellectual Freedom

DR NORMAN R CAMPBELL (NATURE, August 8 p 208) writes with a certain lack of charity about the numerous men of science medical men, publicists, and so forth, who have ventured to inform themselves about birth control To seek knowledge about the origin of species, he informs us, may be honest and honourable, but "knowledge concerning contraception is sought, either from mere prurience, or from intention to practise it or to teach others to do so" But that is just what a Tennessee Fundamentalist would say about curiosity about evolution He would say men wanted to know they were beasts in order to make beasts of themselves It is impossible to let Dr Campbell's sweeping indictment pass unchallenged People in general want to know about this matter in order to judge it, they want to know the nature, the naturalness, the physical good or evil of these practices and what the mental and social reactions of this or that line of action may be It is no more "prurient" to be intelligently interested in the question than in dietary No one wants the publicly paid medical man to "propagate" this knowledge where it is not desired But we do want to see him free to give it, cleanly and discreetly, to people who know already that it exists and who will, failing him, probably seek it in shameful and dangerous ways We object to any sect or section of the community coming with threats of dismissal and injury between him and those who want to know And while this is the case in Britain I decline to line up to sneer at the Fundamentalists of Tennessee

H G WELLS

The Theory of Photographic Sensitivity

By Dr T SLATER PRICE, F R S , and S O RAWLING

SINCE 1920 our knowledge of the formation of the latent image has been greatly increased by investigations which divide themselves roughly into three chapters The first notable advance was made by Svedberg during the years 1920–1922, and consisted in the proof that the latent image consists of small centres distributed on the silver halide grains of an exposed photographic plate, the distribution of the centres being entirely according to the law of chance A grain is not developable unless it contains at least one such centre The second step was to decide upon the origin of these development centres Two theories were advanced In one of these it was assumed that the light itself formed the centres, the grains themselves being supposed to be homogeneous In the other, it was assumed that there exist in the grains, prior to exposure, nuclei which are not silver halide and which are formed during the manufacture of the emulsion, and that the action of light is to change their condition in such a way that they become centres at which development can start The first theory was extensively investigated and modified by Silberstein and others in the Research Laboratories of the Eastman Kodak Company, whilst the second was developed by Toy in the laboratories of the British Photographic Research Association Direct evidence in favour of the second theory was at length obtained by Clark in the latter-named laboratories

The third advance has recently been concisely summarised by Sheppard (Jour Franklin Inst , 1925, 200, 51), and deals with the nature of the nuclei postulated in the second theory mentioned above If the nuclei are light sensitive, and are essentially different from silver bromide, their spectral absorptions should determine the spectral sensitivity of the material, or, at any rate, powerfully affect it The relative spectral sensitivity of plates before and after desensitising with chromic acid is found to be the same, however, and the distribution of sensitivity corresponds approximately with the absorption spectrum of gelatino-silver bromide (Sheppard, Wightmann, and Trivelli, Jour Franklin Inst , 1923, 196, 653) Moreover, the experimental relation between the quantity of the incident light energy and the photographic effect produced is just what is to be expected when allowance is made for the light absorption of the silver bromide, the agreement being all the better when the light absorbed is reckoned in quanta (Toy and Edgerton, *Phil Mag* , 1924, 48, 947)

As a result of the consideration of the above facts, the following theory of the nature of the nuclei has been arrived at It is assumed that the action of light is to decompose the silver bromide into bromine and silver, and that the apparent sensitising action of a nucleus or "speck" is confined to increasing its size by accretion of photochemically reduced silver atoms until it is large enough to form a development centre The mechanism by which this accretion is supposed to be brought about is, apparently, that light is absorbed all over the grain and that the energy of vibration of the electrons in the atoms of the silver halide crystal is thereby increased , but, as a rule the transfer of an electron from bromine to silver only occurs in the boundary layer at the surface of the specks Thus energy flows from the surrounding crystal lattice to the specks where it is released as chemical work, the transfer from distant atoms occurring by radiationless collisions (vibrations) through neighbouring atoms until the edge of the speck is reached It may be noted that Toy (*Phot Jour* , 1921, 61, 420) ascribed to Slade a somewhat similar idea as to the transference of energy within the crystal , at that time, however, the attempt was made to explain on this basis how development centres might be formed by light action without the aid of sensitising specks, the mechanism of the action being a kind of "surging" of energy within the crystal and the consequent formation of development centres where energy sufficient to bring about the necessary chemical decomposition is momentarily concentrated The new theory may thus be considered to be an extension of Slade's original idea to that of the existence of sensitising specks

According to Sheppard, the formation of the specks is due to casual adsorption and reaction with the silver bromide of a substance present in the gelatin The theory given leads to the conclusion that once a speck is formed it tends to increase in size , further, not only will the average number of specks on large grains tend to be greater than on small ones in the same emulsion, but also the average size of speck will be greater It further follows that the sensitising power of any speck is a function of its size A large speck would not require so large an amount of chemical decomposition in its neighbourhood as would be required by a small speck in order to make a development centre Svedberg had already touched on the idea that a certain minimum size of speck is necessary before it can act as a development centre, and Clark had deduced that it must be such that it contains somewhere about 300 atoms of silver

The theory of the distribution of the specks is therefore in striking agreement with the conclusion arrived at by Toy in 1922 (*Phil Mag* , 1922, 44, 368) that there are two reasons why large grains are, on the average, more sensitive than small ones First, there are more nuclei (specks) present in the larger grains, so that a single grain has a greater chance of having at least one , and secondly, the average sensitivity of the nuclei increases with the size of grain

There is a third factor which may possibly assist in making large grains more sensitive than small ones Specks on large grains have a greater volume of silver halide from which the absorbed energy necessary to produce the photographic effect may be drawn

The investigations which led up to the point marked by the theories outlined above furnish no direct evidence of the chemical nature of the specks Rapid advances were being made in various laboratories towards the solution of the problem, when a paper of Sheppard, from the Research Laboratories of the Eastman Kodak Company, appeared, in which it is

shown that silver sulphide is a substance which can act as a general sensitiser of the kind described Sheppard (*Phot Jour*, 1925, 65, 380) directs attention to the well-known fact that some gelatins are photographically active, whilst others are relatively inert Making use of the unrivalled facilities of such an organisation as that of the Eastman Kodak Company, which has its own gelatin manufactory, several thousand gallons of deliming liquor, which is formed in the manufacture of gelatin, and was found to be photographically active, were concentrated by appropriate treatment, active fractions being separated from time to time Ultimately, after some years of investigation, the active substance was tracked down and identified as allyl isothiocyanate, or allyl mustard oil In the course of manufacture of a photographic emulsion, this substance reacts with the silver halide grains to give the silver sulphide specks to which reference has been made above It is estimated that photographically active gelatin contains only about 1 part per 1,000,000 to 1 part per 300,000 of the sensitising substance Other sulphur compounds have been found to act in a similar manner, a necessary condition seeming to be that the sulphur must be doubly linked to another atom, and not singly linked to two other atoms The analogous compounds of selenium and tellurium act in a similar way

The presence of a speck of silver sulphide in the silver halide crystal would result in a disorientation of the silver and halogen atoms at the common boundary, and consequently give rise to a region of instability in its neighbourhood, a view which is supported by the work of von Hevesey (*Z physikal Chemie*, 1922, 101, 337)

In all the work which has contributed to the achievement of the present position in regard to photographic sensitivity, it is remarkable how interwoven the ideas of various investigators have become A mass of evidence from very different sources has now been accumulated in support of the theory that the high sensitivity of the modern photographic plate is due to the presence, before exposure, of minute traces or specks of some "impurity" on the surface of the silver halide grains in the emulsion The work of Sheppard is a great step forward and opens up new avenues of research, but much work remains to be done before the problem of photographic sensitivity is finally solved

Sino-Himalaya [1]

By F KINGDON WARD

THAT "Any Man's Land" where China, Tibet, and India meet has come into prominence amongst botanists in recent years by reason of the remarkable wealth of flora discovered there, and connected with the problems of plant distribution which arise is the no less interesting problem of geological structure and history A brief description of the physiography of this region may serve to illustrate the nature of these problems

We have as a starting-point the great Himalayan range and the mountainous area of western China East of the 93rd meridian the Himalayan axis trends towards the north-east It seems probable that this axis is prolonged across China, and that structurally it could be traced in that direction to the plains

However, what the traveller, who is unable to follow the strike of the rocks composing a great mountain chain like the Himalaya, sees, is something rather different He sees the Himalayan range ending abruptly at the gorge of the Tsangpo in the great peak of Namcha Barwa, and even if he recognises the peak of Gyala Peri, which forms with Namcha Barwa the gateway to the gorge, as being on the main Himalayan axis beyond the Tsangpo, he can follow it no farther, for the country is unexplored From the Tsangpo gorge eastwards he perceives rather a wide breach in the Asiatic divide, beyond which in the complex skein of mountains which form a network over western China he is unable to pick up the dropped thread of the Himalayan axis, though the facts of both animal and plant distribution in eastern Asia point to its former, if not to its continued existence

That this supposed breach in the Himalayan axis does really exist seems clear enough, though whether at the eastern extremity or in the middle of the range is not so clear

Rising on the plateau of Tibet are several great rivers whose sources are far apart and whose mouths ultimately open on different seas, but all of them, rolling down from the highlands, converge on one another, squeeze through a narrow gap flanked by lofty snow peaks, and separate again as they emerge from the mountains In the west is the Brahmaputra (Tibetan Tsangpo) which, after rounding the great gable end of the Assam Himalaya, swings away to the west In the extreme east is the Yangtze (Chinese Kin-sha), which, after squeezing through the breach, swings away to the east to cross China Between them, but closer to the Yangtze than to the Brahmaputra, flow three other big rivers, the Mekong, Salween, and Taron (or eastern branch of the Irrawaddy)

The extreme breadth of this river gap is about 200 miles, but a much smaller distance—namely, 70 miles—will span the gap between the Yangtze and the Taron, including the gorges of the Mekong and Salween That is to say, these four rivers, where they flow parallel to one another for a depth of about 100 miles, are confined to a strip only 70 miles wide A further peculiarity about this strip is a pronounced tilt from east to west, whereby these rivers flow at successively lower and lower levels as we proceed westwards from the Yangtze to the Irrawaddy

The reasons for this may be at least partly explicable on the theory of isostasy, the vast area of deposition towards the head of the Bay of Bengal being counterbalanced by a rise in the country to the east, which is essentially an area of denudation Even the progressive lowering of the river beds might be due to a detailed isostatic equilibrium, being proportional to their

[1] Substance of two lectures delivered at the Royal Institution on April 3 and 30

powers of erosion and capacity for deposition, according to the views of Colonel Tandy [2]

That the grading of the river beds should follow mechanically from the proportionate rainfall in the gorges seems to us quite untenable If we accept the view that a river is primarily erosive in action, then the Yangtze, with its much greater and more powerful stream and its larger volume of glacier water, should have cut out the deepest channel, but it has not On the other hand, if we accept Colonel Tandy's view that a mountain river bed is primarily an area of deposition, then the Yangtze, which certainly receives a much greater dead-weight load from its arid cliffs than does the forested Taron, should still have sunk its bed lower Moreover, the several source streams of the Irrawaddy show the same progressive decrease in altitude from east to west, though their respective volumes steadily decrease also, and here the rainfall is obviously constant for all

We must not, however, lose sight of the fact that the breaching of the Himalayan axis was probably due in the first instance to tectonic causes, not to river action, and that therefore the parallel gorges owe their origin at least in part to tension, and follow lines of weakness in the crust Here again the weight of material which the crust, immediately to the west, has to support, dragging on the folded rocks of the Burma-Yunnan arc to the east, may have cracked the synclines, for the Burma-Yunnan arc is probably of the same age as the main Himalayan uplift

Prof J W Gregory indeed refers to the Mekong, Yangtze, and other rivers of Chinese Tibet being formed as "tension clefts by the rupture of hard rocks which were pulled apart on the stretched upper side of an arch" [3] However, I can deal here only with results, whatever the causes

The south-west monsoon, blowing up from the Bay of Bengal, strikes against the south face of the Himalaya and drops the bulk of its moisture Thus it crosses the line of high peaks a comparatively dry wind, and the plateau country behind the Himalaya is in consequence semi-desert

The Burma-Assam re-entrant, however, forms a funnel-like approach to the Himalayan gap, and the monsoon rushes like a bore through the neck of the funnel and up the river corridors of the Tsangpo, Irrawaddy, and Salween, with the result that the region lying at the head of the gap, and partly behind the Himalaya, is also drenched with rain Thus the breach, or gap, as we have called it, is the meeting ground of several floras To the north is the Central Asian flora—more particularly the Tibetan element, pressing southwards through the gap, while to the south is the Indo-Malayan flora, squeezing northwards up the river corridors until it makes contact with the former In the east is the Chinese or Oriental flora, while confined to the ranges which form a network over the whole area is the Alpine or Himalayan flora

On the parallel ranges of the Burma-Yunnan arc is found a flora related on one hand to the Chinese flora generally, on the other to the Himalayan flora, and it would appear that these mountains, having received contributions from both the broken ends of the Sino-Himalayan ranges, have carried this flora far to the south

Nothing was previously known of the flora round the knee-bend of the Brahmaputra, however, and it was not until 1924 that, through the kind offices of the Indian and Tibetan governments, permission was granted for a botanical expedition, financed by the Royal Society and the Percy Sladen Memorial Fund

One would naturally suppose that the alpine flora of the Assam Himalaya would more closely resemble that of the Sikkim-Bhutan Himalaya than it does that of the Burma-Yunnan arc, for while the Assam Himalaya stand about midway between Sikkim and Yunnan, the Himalaya form a continuous uplift from Sikkim to Namcha Barwa, whereas the Yunnan ranges are a separate uplift sundered from the Himalaya by several deep river gorges Yet the reverse was found to be the case

If we examine the more prolific genera, such as Rhododendron, Primula, and Meconopsis, we find groups common to the Assam Himalaya and to Yunnan which have no representatives in Sikkim To take a few examples There exist a group of creeping Rhododendrons of the 'Sanguineum' series, previously known only from Yunnan and Burma, now recorded from the Himalaya, they do not extend so far west as Sikkim Similarly with the undershrub Rhododendrons belonging to the 'Saluenense' and 'Campylogynum' series

Coming next to Primula, the section known as 'Sikkimensis' has representatives both in Sikkim and in western China, but hitherto no purple-flowered species was known to occur west of the Mekong, yet such purple-flowered species are abundant in the Assam Himalaya and to the north Again, the queer Primulas which fall into the section 'Maximowiczii' have hitherto been regarded as confined to western China, but two species, possibly identical with the Chinese types, have now turned up in the Assam Himalaya

Two species of the section 'Dryadifolia,' one of them *P dryadifolia* itself, hitherto known only from Yunnan, are now definitely recorded as Himalayan, while the 'Nivalis' section, so richly represented in China and so poorly in Sikkim, obtains additional support as a Himalayan group in half-a-dozen species from Namcha Barwa

In the genus Meconopsis we find exactly the same thing—a closer association with Yunnan than with Sikkim Amongst the 'Grandes,' for example, we find in the Assam Himalaya two yellow-flowered poppies almost exactly like the Chinese *M integrifolia* and its so-called variety *M integrifolia* var *Souliei*, while a species closely allied to *M impedita* is abundant The only Sikkim species met with were such as are common to Tibet or to the Himalaya generally, *e g M simplicifolia* and *M horridula*

One could multiply examples, but enough has been said to bring out the Sino-Himalayan relationship I have selected these genera as being those with which, from a horticultural point of view, I am best acquainted, but I believe that when the whole collection has been worked out, this unexpected relationship will be more strongly emphasised There is also, of course, a considerable endemic flora

From this it would seem that not only is the present breach between the Himalaya and the Burma-Yunnan

[2] *Geographical Journal*, May 1921
[3] *Geographical Journal* March 1923

are recent, but that the linking up of the Assam and Sikkim Himalaya is also recent; otherwise their floras should more closely resemble one another, since they are under almost identical conditions.

The most striking feature of the country immediately to the north of the Tsangpo bend is the number of ice-worn valleys and the extent to which deglaciation has gone on and, judging by the retreating glaciers, is still going on. The Tsangpo valley above the gorge seems to have been in part at least formed by ice action. At all events it is certain that the glaciers of Namcha Barwa once crossed the present valley, since one sees huge amounts of moraine material, continuous with "living" moraines on the right bank, piled up on the north bank, and afterwards cut through and stranded, terrace on terrace, by the river. The gorge itself, however, is clearly due to water erosion, though at one point a glacier does actually reach the river bed from the north bank. This retreat of the ice must be due to gradual desiccation rather than to a general increase of temperature, since lakes are also drying up, and these would scarcely be affected by a small rise of temperature. This ice action is far more conspicuous in the Assam Himalaya and on the ranges to the north of the Tsangpo bend than in other regions we visited; and it might be that the elevation of the Assam Himalaya is of more recent origin than that of the Himalaya as a whole. If, as Sir Sidney Burrard [4] has suggested, the Tsangpo originally flowed from east to west, then there must have been much less accumulation of silt in the Assam valley formerly than there is now, with the result that there would be less "compensation" needed. The cutting through of the Himalayan axis by the Dihang and the "capture" of the Tsangpo would soon alter this, and the Assam Himalaya might have been considerably raised as a result. But with the rise of this great rain screen, the doom of the glaciers to the north was also sealed. The removal of this enormous weight of ice, and the consequent transport of a huge amount of abraded material by water to the Bay of Bengal, would still further have loaded the crust in that direction and released it in the Himalayan area.

The numerous considerable falls in the Tsangpo gorge and the steep grade of the bed suggest that this river is much newer than the Salween or the Mekong. Thus the Assam Himalaya might be regarded rather as an outlier of the Burma-Yunnan arc, severed from it by the cutting back of the Brahmaputra (or Dihang), and still bearing a very close resemblance to it in its flora.

[4] 'A Sketch of the Geography and Geology of the Himalaya and Tibet.'

Science and Intellectual Freedom

By WATSON DAVIS and DR. FRANK THONE, Science Service, Washington, D.C.

AMERICAN men of science naturally felt considerable interest in the trial of John T. Scopes, high school teacher, at Dayton, Tennessee, for the alleged violation of the now famous anti-evolution act on the statute books of that State. Relatively few scientists in this country are directly threatened by the epidemic of anti-evolution legislation, for this is at present confined largely to the southern States, and the majority of the more important colleges and universities, both independent and State-supported, are in the north and west. However, interest in the continued academic independence of their colleagues in the south brought a number of scientists to Dayton as scientific coadjutors for the defence counsel, while many more had signified their willingness to attend if called upon. They would have appeared as expert witnesses also, had the judge not ruled against the admissibility of scientific testimony.

Certain aspects about the outcome of the case may possibly need a word of explanation to those unfamiliar with American law procedure and with the somewhat peculiar circumstances of this particular trial. The defence did not attempt to prove that their client, Mr. Scopes, had not violated the statute as interpreted by the court. They stated that they intended to prove that the law was contrary to the constitution of the State of Tennessee and to the constitution of the United States, and that it was so vague and unscientific in its structure as to be meaningless. For this reason they wished to introduce scientific testimony; and when the court ruled that such testimony was irrelevant, the ground was cut from under their feet. It was conjectured, however, with a good deal of probability, that two or three men on the jury, irritated over the conduct of the case, were prepared to "hang the jury" and prevent the unanimous verdict necessary to convict. The counsel for the defence wished to prevent such an outcome, for then the case would have had to be tried all over again before another jury, with the outcome just as unpredictable as it was the first time. Therefore we were treated to the unprecedented spectacle of the chief counsel for the defence virtually appealing to the jury to convict his client, so that the case might be carried to a higher court on appeal.

Mr. Scopes was accordingly adjudged "guilty", and the case will come before the supreme court of the State of Tennessee in September. This tribunal may do one of two things: either decide that the lower court was in error in certain of its rulings and remand the case for re-trial, or declare the statute to be contrary to the constitution of the State. Appeal may also be taken to the United States supreme court, on the ground that the statute is in violation of certain clauses in the Bill of Rights appended to the United States constitution. Of course it is impossible to predict the outcome of either of these appeals.

Certain after-effects of this case have already been making themselves felt. An anti-evolution bill, similar to the Tennessee statute, offered in the Georgia State legislature, was decisively defeated by a viva voce vote. The "fundamentalists" wish to introduce a similar measure at the next session of the national congress, but so far have been unable to find a member willing to sponsor such a bill. An effort to enforce a dead-letter clause in the regulations of the Washington, D.C. schools appears to have gone off as a flash in the pan.

The effort to force an Old Testament theocracy upon the American people will continue, but now that the only champion of the movement who enjoyed national prominence has passed away, his cause will probably dwindle accordingly.

Relativity Displacement of Spectral Lines and Stellar Constitution

NOT many months ago, a very careful and critical examination by Dr C E St John of the wave-lengths of the lines in the solar spectrum was sufficient to convince a large body of astronomers that the displacement towards the red of spectrum lines originating in a region of high gravitational potential, required by Einstein's theory of relativity, was an actual phenomenon An element of doubt remained, however, owing to the exceedingly small amount of the displacement in question and the unknown effects of convection currents and other disturbing influences in the solar atmosphere

At the time when Dr St John's investigation was made, it appeared that no source of light other than the sun could afford a satisfactory test of Einstein's prediction, and that for two reasons In the first place, the smallness of the displacement to be measured demanded a degree of dispersion and perfection of detail in the spectrum which it was impossible to obtain with the light of any other astronomical body The relativity displacement depends on the gravitational potential at the surface of a star—that is, on the star's mass divided by its radius—and for no star was this quantity believed to be large enough to give a displacement of more than one or two hundredths of an Ångstrom unit In the second place, owing to the identical character of the relativity displacement and the Doppler displacement arising from motion of a source of light away from the observer (both displacements are proportional to the wave-lengths of the lines concerned), it was necessary to select a body the motion of which relative to the earth was known from independent evidence Since the radial velocities of the stars can be obtained only by means of the Doppler effect, the sun was for this reason also the only body available for the Einstein test

The restriction thus doubly imposed has now been removed, thanks jointly to some remarkable theoretical predictions by Prof A S Eddington and the extremely fortunate circumstance that Nature has provided a means of testing those predictions Certain facts of observation recently led Eddington to the conclusion —which he immediately saw to be a natural consequence of his theory of the constitution of the interior of a star—that matter under stellar conditions might attain densities many thousand times greater than those with which we are familiar among terrestrial materials Not only so, but in the stars known as "white dwarfs," of which two are known, it appeared that these high densities might actually be realised These stars are abnormally faint for their spectral type and colour—a fact which suggests that they have very small surface areas and correspondingly large densities, a given spectral type or colour denotes a definite surface brightness per unit area, and an abnormally small total output of light must therefore mean an abnormally small radiating area Further, the stars are members of binary systems, and their masses can be determined and hence the order of magnitude of their densities One of the white dwarfs is a companion of Sirius, and therefore one of the nearest of the stars This fortunate circumstance has just enabled Dr W S Adams of Mount Wilson Observatory (Proc Nat Acad Sci, Vol 11, No 7, July 1925) to observe its spectrum in spite of its low intrinsic brightness, and thereby to confirm both Eddington's prediction and the reality of the Einstein gravitational displacement

The existence of stars having the extraordinary qualities of the white dwarfs removes the necessity of confining the Einstein test to the sun The extreme compression of the material of the star involves a very high value of the gravitational potential at the surface, and the relativity displacements are of the order of half an Ångstrom unit There is therefore no need to use the high dispersion which would be necessary with normal stars Further, owing to the fact that the star is a companion of Sirius, the space velocity of the two stars must be the same when allowance is made for the orbital motion All that it is necessary to observe, therefore, is the difference in displacement between the lines of Sirius and those of its companion This difference, except for the known amount due to orbital motion, must therefore be due to the excess of Einstein displacement in the companion over that in Sirius itself Working on these lines, Dr Adams has found almost indubitable evidence of the existence of an Einstein shift of the expected order, and a mean density of the order of 53,000 (water = 1)

This remarkable result, which marks a very definite advance in our knowledge of both the foundations of science and the constitution of matter, is interesting on account of the chance which has made it possible as well as for its own intrinsic importance Had it not been for the fact of the existence of a white dwarf which is, at the same time, one of the nearest of the stars and a member of a binary system of which the other star is a normal one, the confirmation could not have been made

Current Topics and Events

IN *Die Naturwissenschaften* of July 17 there appears a report of an address by Prof Miethe on the production of gold from mercury, from which it seems that, in a mercury vapour lamp operated under suitable conditions, gold actually makes its appearance in amounts amenable to chemical tests The necessary conditions are rather difficult to define, but with a suitable form of discharge, the gold yield is proportional to the current strength and the time A definite potential is necessary before any appreciable quantity is observed A mercury vapour lamp *in vacuo* is ineffective, but the same discharge in air at atmospheric pressure gives measurable amounts of gold Again, gold is found after a discharge between two mercury electrodes in paraffin wax in this case the gold makes its appearance not in the liquid mercury but in the wax along the path of the discharge In certain experiments even greater quantities of a metal which closely resembles silver are found

These results are largely confirmed by Prof Nagaoka's work recently described in NATURE of July 18, p 95 Prof Miethe attributes the appearance of the gold to the disintegration of mercury atoms under the influence of electronic bombardment In this report no reference is made to the energetics of the problem, nor is any suggestion given as to the mechanism of disintegration The author admits that the appearance of silver, if silver it is, as a disintegration product of mercury is certainly not to be expected, although, under suitable energy conditions, the conversion of mercury into gold might be anticipated In the same issue there is published a letter from Dr Honigschmidt giving 197 26 as the atomic weight of the gold thus produced, a value identical with that of ordinary gold This determination, in conjunction with Dr F W Aston's measurements of the isotopes of mercury reported in a letter to NATURE of August 8, p 208, throws doubt on the transmutation theory

THE Forestry Commissioners' fifth annual report for the year ending September 30, 1924, shows that steady progress in the work of afforestation in Great Britain has been maintained During the five years, 1919–1924, the area actually planted by the Forestry Commission was 39,469 acres, of which 37,790 acres were with conifers and 1679 acres with oak, beech, and other hardwoods In addition, grants made to public bodies and private persons have resulted in the planting (or preparation, with undertaking to plant) of 42,082 acres The total area planted under the auspices of the Commission was thus 81,551 acres The Commissioners' planting work is entirely dependent on the timely acquisition of suitable land and on the raising of sufficient young trees in forest nurseries It is satisfactory then to learn that the Commission has acquired 141,470 acres of plantable land, of which approximately 100,000 acres represent an addition to the existing forest area of Great Britain, the remainder being felled or devastated woodlands The nurseries established are extensive, and last year's planting of 10,519 acres absorbed more than 22 million young trees On April 1, 1924, the Crown Woods, aggregating 120,648 acres, were transferred from the Commissioners of Woods and Forests to the Forestry Commissioners, and will be managed on the same principles as estates acquired for afforestation The sixteen Crown Woods (New Forest, Dean Forest, etc) and the new areas thirty-four in England and Wales and twenty-eight in Scotland, where planting on a large scale is being carried on by the Commission, are shown in two maps The largest of these planting centres is near Thetford in East Anglia, and here a forest of 20,000 acres is in the making The report gives a full account of the various forestry operations and is replete with tables and statistics It has been issued as a Parliamentary Paper (No 107 price 1s)

SIR ARTHUR KEITH'S description of the fragments of the skull found by Mr Turville-Petre in a cave near the Lake of Galilee, which appeared in the *Times* of August 14, confirms the preliminary report that it is to be assigned to the Neanderthal type It departs from that type, however, in certain characters in which it appears to approach the type of modern man Although resembling most closely the Krapina variety of Neanderthal man, the Galilean man differs from that and all other European specimens in having a narrow and high-vaulted skull and though the eyebrow ridges are massive and strong, the bone enclosing the brain is not thicker than is the rule among modern Europeans The breadth above the ear-holes is estimated at 120 mm and the extreme length at 200 mm, while the volume of the brain may be inferred to have been little short of that of the average modern Englishman, which measures about 1480 c c A further note by Mr Turville-Petre suggests that the flint implements represent a transition culture between Acheulean and Mousterian The predominant types are *coups de poing* mainly small in size, side-scrapers, trimmed flakes, narrow blades many retouched along one edge, and small amygdaloid flakes retouched on the upper surface to form Mousterian points Anthropologists await with much interest the fuller report on the skull, and the account of the excavation of the cave to be given by Sir Arthur Keith and Mr Turville-Petre to the anthropological section at the forthcoming meeting of the British Association at Southampton

WE have received from Mr W Spencer Lake, 248 Valentine Street, Bendigo, Australia, a letter in which he comments on Prof Lloyd Morgan's article on "Optical Records and Relativity" (NATURE, October 18 1924, p 577) In view of the divergence of view with respect to interpretation of *mental reference* to what we speak of as objects of vision, Prof Lloyd Morgan asked whether it is *for the physicist* to pronounce judgment Mr Spencer Lake is of opinion that though most physicists appear to subscribe to the hypothesis of direct apprehension, yet it is doubtful if many could be found who would assert this unshaken confidence in it Rather would they admit that they are concerned with sensual images and a "construct-world" formed by them therefrom It seems to him that the physicist is not called upon to explain to which hypothesis he subscribes because it can in no way affect the physical issue With regard to the transformations of relativity they refer not to events in general but to measures and to physical quantities defined by these measures These measures—spatial and temporal—are arbitrary They depend upon "local spaces" and "local times" What relativity asserts is that, underlying all points of view and all measures however arbitrary, there is some element of "invariability," not in the absolute sense, but in the sense that there is something which is independent of point of view, independent of the particular measure-code adopted, and to be regarded as a 'law of Nature' The transformations of relativity apply to the quantitative equations by which these laws are expressed Thus relativity helps to bring us to a better knowledge of the physical world by eliminating what, in our experience, depends upon the local space and time system, for example, the very special space-time frame of classical mechanics It is not a question of whether the laws

of classical mechanics stand in need of revision or not but whether the physical world is the same for us as it was before the advent of relativity

WE have received Vol I Part I of the Journal of the Ipswich and District Natural History Society It will be remembered that this Society was founded on January 1, 1924, as the result of an amalgamation of the Ipswich and District Field Club and the Ipswich Scientific Society The Society now numbers 250 members and is divided into six sections, dealing respectively with botany, conchology agriculture prehistoric archæology, microscopy, and photography The president is Mr J Reid Moir, whose address on "The Antiquity of Man in Ipswich" appears as the first communication in the Journal Other communications deal with the evolution of the river Stour, by Prof P H G Boswell the Suffolk and Essex Crag Pits by Mr Alfred Bell, Mr J Reid Moir, and the late Mr S A Notcutt and the Suffolk Coast, by Major E S Cooper, who traces changes in the coast-line from the earliest times In view of the importance of the subject we may direct the special attention of students to the paper by Messrs Bell, Notcutt, and Reid Moir, in which the two former give a list of the crag pits, the types of deposit to be found in each, and directions for reaching them, while the latter deals with the character of the sub-crag detritus beds, and the implements found therein, as well as sites on which each may be best studied

THE Report of the Board of Visitors appointed by Congress to inquire into the work of the Bureau of Standards at Washington has been issued and contains much valuable information as to the benefits which have accrued to the United States from the activities of the Bureau The motor car industry alone has been able to effect economies amounting to 3 000 000*l* per annum on account of the investigations on fuels, tyres, and brake linings carried out at the Bureau, while the annual grant to the institution has been less than 400,000*l* The Board emphasises the necessity of more fundamental scientific research, which runs the risk of being given a secondary position in an establishment on which the public makes demands for immediate and profitable returns A similar point was made by the president of the Societe d Encouragement pour l'Industrie nationale in France in his address at the recent annual meeting when he spoke of the importance of aiding those who are carrying out research by placing in their hands the instruments they need and the books and periodicals they must read Owing to the extensive adoption in France of the English Saturday half-holiday, the number of readers who consult the library of the Society on that day has greatly increased

H M STATIONERY OFFICE has of late earned our gratitude by producing many valuable reports in a form that is not merely cheap but also pleasing Now it has still further marched with the times by placing on sale (price 3*d*) at the Government Pavilion of the British Empire Exhibition a "Brief Guide to Government Publications," which is as well and attractively written as any advertisement by a large business house The section on "Science and Technology occupies five of the twenty-two pages devoted to a descriptive classification and that without including archæology, agriculture or fisheries For details the reader is referred to the lists issued by the Departments concerned It is a pity that the Stationery Office should not feel called upon to mention the numerous and important publications of the British Museum at any rate it publishes the Annual Return of that establishment But even as it is, the field to which this pamphlet guides one is astonishing in its extent and variety, few can be familiar with more than a small corner of it

AN interesting account by Francis Buckley of the glasshouses on the Wear in the eighteenth century appears in the Journal of the Society of Glass Technology for June Between 1696 and 1737 at least three glasshouses were built on the Wear, probably by a syndicate called the "Company of Glass-Owners at Sunderland' It is interesting to note that the owners either let the glasshouses or, failing that, worked them themselves About 1741, many glass-makers on the Tyne considered it advisable to acquire the two glasshouses at Sunderland, but the project fell through The paper contains many interesting extracts from contemporary newspapers

THE ever-increasing interest in the problem of securing a purer atmosphere with its resulting benefits should receive further impetus from the Conference to be held at the Palace Hotel Buxton, on October 2-5 under the auspices of the Smoke Abatement League of Great Britain Practical proposals for reducing both domestic and industrial smoke are being prepared by the League for full consideration by those attending, and prominent individuals have agreed to open discussions at various sessions It is hoped that a constructive programme of useful work will be initiated, the results of which can be reviewed at the Smoke Abatement Exhibition and Conference at Birmingham in 1926

DURING Lord Burnham's absence abroad the Duke of Atholl has consented to act as chairman of the Special Appeal Committee of the Imperial College of Tropical Agriculture The first large donation received since he has "fathered' the Fund is one of 1000*l* from Messrs J and P Coats Ltd This generous gift, following closely upon a contribution of 1000*l* from the Liverpool Cotton Association is evidence of the interest which is taken in the Imperial work of the College by the cotton industry Further contributions from those whose interests lie in tropical agriculture should be sent to Mr Algernon Aspinall, Secretary, The Imperial College of Tropical Agriculture, 14 Trinity Square, London, E C 3

DR GEZA ROHEIM of Budapest, whose reputation as an exponent of the application of psycho-analytic methods in anthropological research has grown steadily since the War, and whose study of Australian totemism on psycho-analytic lines has recently been published in Great Britain, will visit England in the

month of September During his stay he will read a paper on Hungarian folklore and primitive beliefs at the Royal Anthropological Institute on a date to be announced later Arrangements are also being made for Dr Róheim to deliver a course of four lectures on psycho-analysis and primitive religion and magic for the Institute of Psycho-Analysis Further particulars may be obtained from Mr John Pickman, the hon secretary of the Institute of Psycho-Analysis, 26 Devonshire Place, W 1, or at 42 York Terrace, N W 1 There will be no charge for admission to Dr Róheim's lecture at the Royal Anthropological Institute, but application for the admission of non-members should be addressed to the hon secretary, 52 Upper Bedford Place, W C 1, after September 1

MR F EDWARDS, 83A High Street, Marylebone, W 1, has just issued an interesting catalogue (No 471) of second-hand books, maps and charts relating to nautical subjects and the South Seas Nearly 1400 works are listed some of which are rare The list can be obtained upon application

IN catalogue No 429, Messrs Bowes and Bowes, Cambridge, offer for sale some 1100 second-hand volumes from the library of the late Dr F J H Jenkinson, librarian of the University of Cambridge The books are of a miscellaneous character, but include some dealing with scientific subjects

MESSRS W Heffer and Sons, Ltd, Cambridge, announce for publication in the autumn "Stars and their Uses," by E B Leggett, a little volume in verse beginning with an introductory definition of common astronomical terms and proceeding to treat of the earth in its relation to the universe In successive chapters it deals with the constellations, circumpolar, zodiacal, and otherwise, and concludes with remarks on the general composition of celestial bodies

APPLICATIONS are invited for the following appointments, on or before the dates mentioned Two assistants in the department of zoology and comparative anatomy of University College, London, namely, a man, preferably with some training in physiology or chemistry, for an appointment renewable annually and a man or a woman to take the place of an assistant absent on a year's leave—The Secretary (August 24) An assistant lecturer in the department of pharmacy of the Technical College, Sunderland—The Chief Education Officer, 15 John Street, Sunderland (August 31) A research chemist, a research engineer, and some junior research chemists at the Chemical Laboratory of the Department of Scientific and Industrial Research Teddington—The Secretary, Department of Scientific and Industrial Research, 16 Old Queen Street, Westminster, S W 1 (September 4) An assistant lecturer in building construction at the Municipal College of Technology, Manchester—The Registrar (September 25) A senior lecturer in philosophy in the University of Melbourne—The Agent-General for Victoria, Melbourne Place, Strand, W C 2 (October 15) A temporary engineering assistant in connexion with the Air Ministry—The Secretary (S I /437), Air Ministry, Adastral House, Kingsway, W C 2 A junior assistant in the Agriculture Science Bureau of the International Institute of Agriculture—The General Secretary, International Institute of Agriculture, Rome

Our Astronomical Column.

BORRELLY'S COMET—A third periodic comet of the six that are due at perihelion in the present year has been found M Schaumasse found Borrelly's comet on August 14 at 3^h 18 2^m univ time in R A $5^h\ 4^m\ 24^s$, N Decl $2°\ 4'$ It was of magnitude 13, the date of perihelion is about October 7 75 The following ephemeris (for 0^h) should be near the truth

		R A	N Decl
Aug	22	$5^h\ 26\ 5^m$	$3°\ 57'$
,,	30	5 49 0	5 56
Sept	7	6 12 0	7 58

It is a morning object, being on the meridian about $7^h\ 15^m$

COMET HUNTING—Mr W Reid, who has been the most successful comet hunter of recent years, contributes an interesting note on his methods to the Journal of the Astronomical Society of South Africa, vol 1, No 5 It is particularly seasonable, since there are apparently no systematic workers in this field in the northern hemisphere, so that an amateur would have good prospects of success in it

Mr Reid laid down for himself the large programme of sweeping the whole southern hemisphere once a month he found it advisable to map all the nebulæ that might be mistaken for comets His instrument is a 6-inch Cooke photo-visual equatorial its definition is very fine, a point that he lays stress upon He makes north and south sweeps in a fixed hour angle, the diurnal motion sufficing to give a new star field at each successive sweep One night is devoted to the western sky, another to the eastern There is little use in sweeping in moonlight or with bad seeing He notes that he often sweeps for five hours or more on a good night, and yet his catches average about one per annum, so that the work requires much patience and perseverance, but he notes the sense of intense satisfaction that success brings

NORMAN LOCKYER OBSERVATORY, SIDMOUTH—The report of the Director of the Norman Lockyer Observatory, Sidmouth, for the year ended March 31 last, shows that much valuable work has been accomplished during the year Five papers on various branches of astronomy have been published, and six others are in preparation The year was nevertheless, a very unfavourable one with respect to weather conditions, only 133 nights having been sufficiently clear for observations to be possible, of these, all but three were utilised During the year the first assistant, Mr W B Rimmer, left the Observatory to take up an appointment at the Canberra (Australia) Solar Physics Observatory, and from November 29 onwards the work was conducted entirely by the Director (Dr W J S Lockyer) and the chief assistant (Mr D L Edwards) The principal work undertaken and completed during the year was the determination of the spectroscopic parallaxes of certain stars and the study of the spectra of some bright-hydrogen-line stars The accounts show an excess of 73*l* of expenditure over income, but it is hoped that, by the formation of an endowment fund, the deficiency of assured income below normal expenditure will be considerably reduced

Research Items

A LATE BRONZE AGE SITE IN SOUTHERN BAVARIA —The results of an investigation of a site near Istein in Southern Bavaria are described by Dr R Lais in vol 24, Pt 2, of the *Bericht der Naturforschenden Gesellschaft zu Freiburg* The finds, some of which have an important bearing on the distribution of ceramic ornament in this part of the Central European area in the later Bronze Age, were derived in part from the surface, in part from excavation Among them were a very fine triangular arrow-head of chert, polished stone axes, stone knives, clay spindle-whorls of double-cone shape and pottery mostly fragmentary, but of sufficient size to show the character of the ornamentation The decoration was in the form of rings in relief, incised dots and marks in lines and groups, parallel grooves, zigzags and dog's tooth It was uniformly geometric with the single exception of a garlanded ornament or series of festoons composed of grooves In regard to dating the arrow-head, axes and knives clearly belong to the Neolithic Age as do the numerous flint-flakes which were found, although some of these would appear to have been used later for the purpose of strike-a-lights The pottery, however, belongs to a later period and may be an extension of the culture of the Black Forest It is compared with pottery from an urn-burial at Rheinweiler, 5 km to the north, and from Aichen, 50 km to the east These two finds are to be attributed to the Bronze Age rather than the early Iron Age as has been suggested The Istein finds may be assigned to the latest phase of the Bronze Age

ABILITY OF TERMITES TO LIVE ON PURE CELLULOSE —In his studies on termites, Dr L R Cleveland has shown that through the agency of the protozoa in their alimentary canal, they are able to digest wood and utilise the products He has kept numerous termites belonging to two genera Termopsis and Reticulitermes in glass vessels and has fed them for eighteen months on cellulose alone, *e g* filter paper (*Biol Bulletin*, April 1925) These termites fed on a pure cellulose diet have behaved exactly as the controls fed on wood Many of the nymphs have become sexually mature adults and have laid a large number of eggs which have hatched normally Larvæ from these eggs have grown even more rapidly than those from eggs laid by some of the wood-fed controls In all the experiments the larvæ now present are greater in number and in weight than the individuals present at the beginning and no deaths have occurred Some of the colonies which began with ten adult termites now include more than two hundred half-grown individuals Attempts have been made to determine whether atmospheric nitrogen is being fixed in connexion with the formation of proteins but no definite result is as yet forthcoming

THE OVIPOSITION RESPONSE OF INSECTS —Bulletin 1324 (April 1925) of the U S Department of Agriculture is devoted to this subject Its author, Mr Charles H Richardson, discusses the various stimuli which affect the oviposition reaction of insects, giving a large number of references to the literature on the subject Temperature is an important factor, and within the range of each species of insect there is probably an optimum temperature for egg-laying Thus, in the case of the Codling moth, oviposition becomes checked at 18 3° C and was found to cease at 16 7° C (Isely and Ackerman) Humidity is likewise very important in many but not all species by increasing the atmospheric moisture from 55 per cent to 96 per cent, egg-laying in *Tomicus typographicus* was delayed from 1 to 7 days (Hennings) Light stimulates oviposition in the house fly but is without effect on the egg-laying responses of *Drosophila melanogaster* (Adolph) Surface contact is a further factor and often very important thus, in the webbing clothes moth, investigations by Benedict and by Titschack suggest that the tactile stimulus may be the determining factor regardless of the food value of the material for the future larvæ Many insects have been found to be attracted by specific odours, but in many cases the nature of the substratum has also to be taken into account in order actually to induce oviposition The simplest oviposition responses are probably shown by those insects which pass most of their lives associated with substances that serve as food for themselves and their offspring Most free-living insects however, require a chain of stimuli to induce normal egg-laying

PIPERINE AS A MOUNTING MEDIUM —Watsons' *Microscope Record* (No 5, May 1925) contains a useful article by Mr Chapman Jones, urging the value of piperine as a mounting medium for certain purposes Its refractive index is 1 68 for the D line, and as it is colourless it is superior to realgar To avoid crystallisation in permanent mounts it should be heated to 180° C for one hour before use, but this is unnecessary for temporary mounts

TEMPERATURE OF GROUND WATER —In a pamphlet issued by the United States Geological Survey (Water-Supply Paper 520 F), Mr W D Collins gives a summary, with maps and diagrams, of water available for industrial purposes in the United States The temperature of ground water is generally from 2° to 3° F above the mean annual air temperature if the water is between 30 and 60 feet below the surface At a depth of 10 feet the temperature may range from 10° above to 10° below the mean annual temperature An approximate average increase may be taken as 1° for every 64 feet The mean monthly temperature of surface water is generally within a few degrees of the mean monthly air temperature when the latter is above freezing point In the warmer months the maximum water temperature is usually 2° to 6° higher than the mean monthly water temperature.

ANTARCTIC TERRESTRIAL MAGNETISM —The first volume of Series B of the Scientific Reports of the Australian Antarctic Expedition of 1911–1914 under the leadership of Sir Douglas Mawson is devoted to terrestrial magnetism The field observations are dealt with by Mr E N Webb, and Dr Chree discusses the magnetograph curves The instruments were lent by the Carnegie Institution of Washington and consisted of two magnetometers, a Dover and a Lloyd-Creak dip circle Observing stations were established on Macquarie Island, at Cape Denison Adelie Land, and at Queen Mary Land, and sledge journeys were made along the coast, across Adelie and King George Land, towards the magnetic pole, and across Queen Mary and Kaiser Wilhelm Lands As a result, the south magnetic pole was found to be at 71° 10′ S, 150° 45′ E, and the lines of equal dip to be ellipses with their major axes north-west to south-east The horizontal component of the field was found, partly by the magnetometer, partly by the dip circles, which were provided with deflecting needles The polar diagrams showing the daily variation of the north and west components are slightly elliptic with their major axes east and west for Adelie Land while the Scott expedition found them nearly circular for Cape Evans

WEATHER AT HONG KONG.—An annual summary of the meteorological elements at Hong Kong, with the typhoon tracks in the neighbouring sea and the results of magnetic observations during 1924, are given in the *Monthly Meteorological Bulletin* for December last. The discussion is prepared under the direction of Mr. T. F. Claxton, the Director of the Royal Observatory. No text is given with the voluminous tables, but the latter are prepared with great care and precision. Barometric pressure uncorrected for height above sea-level ranged during the year from 30.31 in. in November to 29.37 in. in July; the highest monthly mean was 30.06 in. in January, and the lowest 29.60 in. in July. Air temperature in the shade ranged from 93° F. in September to 48° F. in January; the highest monthly mean was 82.2° F. in September, the lowest 60.3° F. in February. The total rainfall for the year was 98.57 in., which is nearly 14 inches more than the normal for 40 years; the monthly fall was heaviest in June, but the maximum in an hour was 1.74 in. in May. The brightest month was November with 254 hours of sunshine, and December was the next brightest with 238 hours. The maximum hourly wind velocity was 46 miles in October; the highest in a squall was at the rate of 69 m.p.h., also in October. Two plates are given showing the tracks of typhoons and depressions in the Far East during the year 1924; the tracks very often pass north-eastwards over the neighbouring sea, but others strike inland, passing from east to west in the neighbourhood of Hong Kong. The report of the Royal Observatory, Hong Kong, for 1924, shows that Hong Kong was not visited by a typhoon during the year.

THE DISINTEGRATION OF NITROGEN AND OXYGEN.—The volume of Communications from the Vienna Institute for Radium Research for 1923–24 contains a paper by Dr. G. Kirsch on the disintegration of nitrogen and oxygen by means of swift α particles from radium C. The nitrogen was prepared from the air by absorption, the oxygen from pure potassium permanganate, and the scintillations produced by the products of the disintegration were observed on a zinc sulphide-copper phosphide screen. For nitrogen the expelled α particles have ranges up to 11.4 cm., and the H particles up to about 28 cm. For oxygen the great majority of the α particles have ranges less than 9.3 cm., but there is evidence that for ranges in excess of 9.3 cm., H particles are present in greater abundance than α particles, so that it is not safe at present to conclude that in the disintegration of oxygen H particles are not produced. The author considers that the experimental facts support Pettersson's theory that the α particle causes an explosion of the nucleus, the products moving away in all directions equally, rather than the theory of Rutherford and Chadwick, that the momentum of the α particle is communicated by impact to a portion of the nucleus.

THE RESONANCE LINES OF NEON.—The spectrum of neon in the extreme ultra-violet has been recently investigated by Dr. G. Herz, using a vacuum grating spectrograph (*Zeitschrift für Physik*, June 30). Two strong lines, with the wave-lengths 735.7 ± 0.5 Å.U. and 743.5 ± 0.5 Å.U., have been photographed, the frequency difference between them being 1428 ± 3 cm.$^{-1}$, which agrees with the difference between Paschen's $1s_2$ and $1s_4$ terms. The two lines are to be regarded as combinations of these two terms with the fundamental term, and are the resonance lines of neon. Paschen had already resolved the spectrum of neon into a complicated system of series, but the term corresponding to the normal condition of the gas was not determined by him, as these extreme ultra-violet lines had not been observed. The author concludes that the normal state of neon is a p state, and that the inner quantum number to be ascribed to the fundamental term is $J = \frac{1}{2}$ (Landé's notation), or $j = 0$ (Sommerfeld's notation). A provisional value for the magnitude of the fundamental term is 173970 ± 100 cm.$^{-1}$, but more accurate measurements of the wave-lengths are necessary to obtain a definite value. The paper contains an account of the apparatus made use of in obtaining these results. Owing to the strong absorption of the resonance lines in neon, it was necessary to use a low voltage arc in close proximity to the slit, in a space filled with pure neon at about 4.5 mm. pressure. The light passed through the slit into the spectrograph tube, the pressure of the pure neon in which was about one-thirtieth of this, so that although the light had to pass through a considerable distance to the grating and then to the photographic plate, the absorption was not excessive, and satisfactory photographs of the two lines were obtained. The two ionisation voltages of neon as calculated from these observations are 21.47 and 21.57 volts. This agrees well with the value 21.5 volts measured by Hertz, using the electron collision method.

NITROGEN FIXATION.—The mechanism of the fixation of nitrogen as sodium cyanide has been investigated by E. W. Guernsey and M. S. Sherman, who have published their results in the Journal of the American Chemical Society for July 1925. In the process, sodium carbonate and carbon are heated with finely divided iron as catalyst; the equation of the total reaction is $Na_2CO_3 + N_2 + 4C = 2NaCN + 3CO$. It is now shown that the intermediate reactions are (i.) the reduction of sodium carbonate to metallic sodium, (ii.) the formation of sodium carbide from the elements, and (iii.) the absorption of nitrogen by gaseous sodium carbide to form sodium cyanide. Iron has a marked catalytic effect on the absorption of nitrogen by sodium carbide but does not appear to be essential for the reduction of sodium carbonate or for the formation of sodium carbide.

ORGANO-ARSENIC COMPOUNDS.—An account of the chemotherapy of organo-arsenic compounds, by Dr. G. M. Dyson, is published in the *Chemical Age* for July 25. Ehrlich was the first to raise chemotherapy to the level of a science. Three separate aspects of disease treatment attracted his attention, namely, the disappearance of malaria parasites from the blood by the administration of quinine, the decrease of syphilitic symptoms with the use of mercury, and the destruction of various trypanosomes and spirillæ by the use of arsenic compounds. Ehrlich considered some chemical combination occurred between the drug and some specific chemical group in the parasite (receptor group), thus either killing the parasite outright, or preventing it from functioning in an injurious manner (parasitotropism). The most vital problem in the chemotherapy of receptor groupings is that of determining the relationship between chemical constitution of the curative compounds and their pharmacological action on the receptor groups. Working on these lines, Ehrlich discovered the enormous spirillicidal activity of compounds containing the arseno group, —As=As—. The manufacture of salvarsan, the most important and valuable remedy for syphilis, is described fully. Other arsenic compounds, still more or less in the experimental stage so far as therapeutic action is concerned, are also described.

Southampton Meeting of the British Association

Provisional Programmes of Sections

FROM the local arrangements outlined in our issue of August 15, p 251, and from the provisional programmes of the sections, it is evident that all who attend the Southampton meeting of the British Association will find that the time is very fully occupied The brief statements below of outstanding features of some sectional programmes, for which we are indebted to the respective recorders, will serve to indicate the fare which is to be set before the members of the Association

Section A (Mathematics and Physics)

The programme of Section A (Mathematics and Physics) presents some interesting and novel features Under the presidency of Dr G C Simpson, Director of the Meteorological Office the subject of meteorology will naturally receive considerable attention, which is in keeping with the great present-day importance of this branch of science

The business of the Section opens on Thursday August 27, with a paper by Prof Orstein of Utrecht foreign guest of the Association on the quantum theory of dispersion, he will be followed by several speakers on subjects in spectroscopy The presidential address on Friday on the new ideas in meteorology will demonstrate the great strides which have been made in the subject in the last decade The president will be supported by the leading meteorologists in Great Britain, several of whom have promised papers to which the Friday and a portion of the Tuesday sessions will be devoted On Monday, August 31, there will be a joint discussion with Section C (Geology) on "Variations in Gravitational Force and Direction and its Relation to Geological Structure," a subject upon which a committee of the Section has been working for some time, and upon which many physicists will welcome information because of its considerable industrial import On Tuesday, September 1, Prof Appleton will discuss some problems in thermionic valves, and he will be followed by several speakers on allied problems

An excursion to the Air Ministry Seaplane Station at Calshot has also been arranged

Section B (Chemistry)

One of the features of the meeting of Section B (Chemistry) will be a joint discussion with Section G on the ignition of gases This will take place on the Friday morning, and will be opened by Prof H B Dixon Two other discussions have been arranged by Section B, one on Thursday morning having for its subject surface catalysis which will be opened by Dr E K Rideal, and the other on Tuesday morning, on the alternating effect in carbon chains, to be opened by Dr B Flurscheim

The presidential address to the Section will be delivered on the Monday morning, when Prof C H Desch will take as his subject "The Chemistry of Solids"

Among other papers of general interest which will be submitted to the Section, mention should be made of a contribution by Prof E C C Baly entitled "Further Investigations on the Photosynthesis of Naturally-occurring Compounds," a paper by Prof H E Fierz, of Zurich, on "The Liquefaction of Wood and Cellulose and some General Remarks on the Liquefaction of Coal," and a paper by Mr E A Ollard, of the Metropolitan-Vickers Electrical Company, on "The Resistance to Corrosion of Electrodeposited Chromium"

Section E (Geography)

Owing to this year's meeting being held in Southampton, the home of the Ordnance Survey, Section E (Geography) will devote special attention to papers on survey and cartography Col Com E M Jack will speak on the work of the Ordnance Survey and Captain J G Withycombe on its recent productions Mr O G S Crawford will deal with archæology in survey maps Mr A R Hinks is to devote his presidential address to the science and art of map-making The relations between geography and anthropology are evident in a paper by Mr H Sumner on geography and prehistoric earthworks in the New Forest The present state of the international map on the scale of 1/1,000 000 is to be described by Major M N Macleod, and the question of pronunciation tables for the British sheets by Mr J H Reynolds In exploration and field work, Prof J W Gregory will discuss the problems of the Queensland Barrier Reef and the most suitable site for boring while Mr F G Binney will give an illustrated lecture on his recent travels in North-East Land, Spitsbergen Dr Vaughan Cornish introduces a new subject in his paper on subjective variations of magnitude in natural scenery A paper of current interest will be that of Mr F J Richards on the cultural geography of India Prof W M Hobbs will contribute a paper on the glacial anticyclone

Section F (Economic Science and Statistics)

Two matters of great importance at the present time, both to economists and to farmers, are to be discussed in a joint session of the Agriculture and Economic Sections One is the question of farming costs in relation to farm management, on which a paper is to be read by Mr J Wyllie, the other will be raised in a paper by Mr R B Forrester on the marketing of agricultural produce In the present crisis in British farming these two papers are of especial interest

At a time, too, when wages problems in our chief industries are pressing for solution, the address of the president, Miss Lynda Grier on the meaning of wages is equally timely This paper will be supplemented by one by Mrs Stocks on the economics of family endowment, and another by Mr R F Harrod dealing with trade crises and the distribution of wealth among the factors producing it The problem of population is to be considered in two papers, one by Mr G F Shove on the law of diminishing returns in agriculture and its bearing on population, the other by Mr P Sargant Florence on "Over Population and the Statisticians"

Two aspects of the financial situation will be considered Mr R G Hawtrey will deal with the gold standard and the balance of payments, and Mr P B Whale with German finance and the Dawes report In addition there are papers by Miss I F Grant on the enclosure movement and Scottish arable land, by Mr Fabian von Koch on unemployment relief in Sweden, and by Dr John Hulme on recent developments in Italy's textile trade

A new feature this year is the Transport Sub-section Six papers are to be read, dealing with the technical and economic aspects of transport by railways, roads, canals, and docks

Section G (Engineering)

The president of Section G (Engineering), Sir Archibald Denny, will deliver an address on "Fifty

Years' Evolution in Naval Architecture and Marine Engineering" During this period very remarkable developments have taken place in the construction and equipment of ships, and in this development science and scientific research have played a very important part

After the presidential address Mr Edwin R Mumford will discuss the important question of the comparison between the speeds and powers of models and ships, and after an account of the pioneer work of Dr William Froude, will show how the method has been applied to solve numerous problems of ship and propeller design, the problem of "cavitation" will also be discussed Mr Foster King will trace the development of the scantlings of modern steel ships and show the hindrance to development which resulted from strength calculations not having been used in wood construction Mr F E Wentworth Sheilds will describe the quay walls of Southampton, certain of which have been proved unstable owing to the nature of the foundations He will give the history of the walls and discuss the various remedies adopted to render the walls stable Mr W G Turner will describe the electric power station at Southampton, and Mr H Wauchope will deal with the electric supply and plant of Southampton Docks Mr Stanley S Cook will discuss the efficiencies of steam turbines for marine purposes and the problem of auxiliary machinery and fuel consumption, and Mr Western Hutchinson will read a paper on "Sailing and Motor Craft, the Scientific Aspects of their Design"

At the joint discussion with Section B (Chemistry) on "Ignition of Gases," Prof W T David will give some account of experiments on the spontaneous ignition of gases and upon the influence of nitrogen and other gases and also infra-red rays upon ignition temperatures and rates of ignition respectively Mr C E Le Maistre will read a paper on engineering standardisation, and Vice-Admiral Sir Robert Bland Dixon and Mr T Berry are to discuss the problem of technical training for naval constructors and engineer officers Prof David Ellis will give an account of an investigation into the responsibility of iron bacteria as constructive agents in the formation of incrustation in pipes In the special case investigated, in spite of every appearance of bacterial responsibility, the incrustation in pipes was found to be due to other causes

The problem of landslides will be dealt with by Mr Edgar Morton and Mr Oliver E Simmonds will describe the construction of modern seaplanes Experimental demonstrations of flow of water in pipes are to be given by Prof Eustice, and Prof J G Gray is to give demonstrations with the gyroscope Prof J J Guest is to discuss the dynamics of motor cars Visits are being arranged to the seaplane station, to Southampton Docks, to an Atlantic liner, to the railway works, aeroplane works, and to Agive oil works

SECTION H (ANTHROPOLOGY)

In Section H (Anthropology), Dr T Ashby in his presidential address will deal with "Engineering in Ancient Rome" In view of his special interest in Romano-British studies, a survey will be made of our present knowledge of Roman Britain in a series of communications dealing with recent excavations in England, Wales, and Scotland Not only will much of the material of these papers be described here for the first time, but a great deal will be the result of work carried on during the present summer

In prehistoric archæology may be mentioned communications by Miss D A E Garrod on the Upper Palæolithic in Britain on the Neolithic period by Mr O G S Crawford, who will deal with changes of climate and megalithic migrations, by M Z le Rouzic on megalithic monuments in Morbihan, France, and by Mr E T Nicolle, who will describe the important Bronze Age mound recently excavated in Jersey Mr H J E Peake will raise the question of archæological distribution maps Certain aspects of the question of the antiquity of man will be discussed by Sir W Boyd Dawkins, and Mr W P Pycraft will offer suggestions for a new classification of man Sir Flinders Petrie's description of recent finds of relics of early man in Egypt is of special interest in view of the correspondence which followed the preliminary announcement of these discoveries in the Press The Section will also have an opportunity of discussing recent results obtained by the American archæological expedition to the city of Carthage, which will be described by Mr Harden

Other branches of anthropological studies will be well represented, as, for example, by Capt Pitt-Rivers' account of the natives of the Island of Aua, New Guinea, and their customs and mode of life, and by Capt Hilton-Simpson's description of the industries of the Shawiya of the Aures Mountains, Algeria, which will be illustrated by cinematograph films taken by Mr J Haseler Mr Talbot Rice, a member of the Oxford expedition to Kish in Mesopotamia, will describe the physical characters of the modern Arabs in that area Some interesting questions relating to heredity in man will be raised by Dr R N Salaman's study of facial types in the Jewish community, which should give rise to a profitable discussion

Exceptional interest attaches to Mr Turville-Petre's account of his excavations on behalf of the British School of Archæology in Jerusalem, in caves near the Lake of Galilee, which have brought to light important evidence bearing on palæolithic man in Palestine, and Sir Arthur Keith's report on the skull showing affinities with the Neanderthal type discovered there These communications are the first detailed description of this important discovery to be given in England

SECTION I (PHYSIOLOGY)

The programme of the Section of Physiology opens with three papers on carbohydrate metabolism, the first of these will be given by Prof J J R MacLeod, in whose laboratory at Toronto insulin was first prepared, and the second by Dr C H Best, who, together with Dr Banting, effected the preparation Prof MacLeod's communication deals with the carbohydrate metabolism of cold-blooded animals Dr C H Best will read two short papers on (*a*) the nature of insulin, (*b*) the mode of its action A third paper of considerable interest will be that of Mr H P Marks, who has made some striking observations in relation to the action of the thyroid gland in carbohydrate metabolism He has found that after prolonged administration of thyroid gland by the mouth to rabbits, a condition ensues in which the injection of sugar produces the same train of severe symptoms as attends the injection of insulin His results have an important bearing on the cause of the lowered sugar tolerance in hyperthyroidism

Prof A V Hill, whose work on the mechanism of muscular contraction was rewarded by a share of the Nobel prize for medicine for 1922, will deliver his presidential address on the physiological basis of athletic records on Monday, August 31, and the address will be illustrated by cinematograph He has analysed the factors limiting muscular effort, and, as a result of observations on the isolated muscle of the frog, has been able to deduce what athletic records should be in man Work recently carried out in Prof Hill's laboratory, in which the processes

taking place during continuous activity of the isolated muscle of the frog and of human muscle are directly compared, will be described in a paper by Prof K Furusawa on Thursday morning August 27

A lecture will be given on Friday afternoon by Mr J E Barnard on the microscopic observation of small bodies Mr Barnard's name has of course, recently been associated with reports of the observation and photographic reproduction by means of ultra-violet light of a cancer virus, the existence of which was demonstrated by Dr W E Gye The size of some of the bodies has been closely determined and is believed to be 0 072μ, so that Mr Barnard's achievement is considerable

On Thursday afternoon there will be a joint discussion with Section D (Zoology) on the functional significance of size, to be opened by Mr J B S Haldane On Tuesday morning there will be a joint discussion with Section J (Psychology), to be opened by Prof T H Pear, on the acquisition of muscular skill

Sectional excursions have been arranged for Monday and Tuesday afternoons, the first to the Anti-Gas School at Tipnor and to the Diving Tank at Portsmouth, and the second to the Fort Grange aerodrome, where some of the tests applied to candidates for the Royal Air Force will be demonstrated

SECTION J (PSYCHOLOGY)

Differential methods have a prominent place in the programme of Section J at Southampton, where the term "differential" is applied either to a comparison of the reactions to a constant stimulus of two groups differing in one condition, or else to a comparison of the reactions of a group (or two equivalent groups) to two or more different stimuli Thus a study has been made of special abilities in arts and science, where "special ability" is meant to apply to a facility developed through special environmental influences and individual interests acting over a number of years and the terms "arts" and "science" stand for the work involved in preparing for first degrees in the corresponding faculties

Similarly the results of testing physically defective children at the Lord Mayor Treloar Hospital and elsewhere lead to the conclusion that physical defect, if widespread and of sufficiently long duration, produces the symptoms of some degree of amentia, and further, that this mental deficiency resulting from physical defect would appear to be appreciably alleviated by exposure to ultra-violet rays

In another study, on the discrimination of wool fabrics by the sense of touch, an attempt has been made to define the differences in judgment between members of the wool trade and the consuming public, and the result suggests a method of measuring the wool-trade sense of touch It is also suggestive of the times that the relationship between buyer and seller is studied psychologically in another paper, where an individual valuation is regarded not as a single price at which the individual concerned will be willing to complete his share of the transaction, but as a whole class of possible prices between which the probability of him completing his share ranges from zero to one

Our final example is a study of the responses of children when taught by various methods, such as the cinema and oral lessons The essays written after the various lessons differed in arrangement of material and also in mode of expression or style

Prof Spearman will open the sessions with his presidential address on "Mental Law of Diminishing Returns" Two joint discussions will be held, one with Section L (Educational Science) on "Recent Investigations upon Vocational Guidance" and one with Section I (Physiology) on "The Acquisition of Muscular Skill"

SECTION K (BOTANY)

The presidential address of Prof Lloyd Williams will deal with the Phaeophyceae and their problems The investigation of this group of seaweeds has been comparatively neglected, and the conclusions of Prof Lloyd Williams, who has devoted a life-study to these plants, are looked forward to with keen interest The study of Algæ will also receive prominence by the communication of several papers on seaweeds

The only joint discussion in which Section K is participating this year is one with Section E (Geography) on "The Evolution and Colonisation of Tidal Lands," to be opened by Prof F W Oliver, who will speak principally upon the stabilisation of these migrating soils by various types of vegetation On the geography side, Prof J W Gregory will deal chiefly with the mode of formation of new land areas by the action of the sea Other speakers in this discussion will be Prof R H Yapp, Dr Vaughan Cornish, Dr E J Salisbury, and Prof S Mangham

Within Section K there will be a discussion on the interpretation of "Adaptive Characters," which will be opened by Prof F O Bower and contributed to by Prof J H Priestley, Dr D H Scott, and Mr G E Briggs The argument to be outlined by Prof Bower will deal principally with certain characters in ferns, to which he has devoted special attention Prof Dame Helen Gwynne Vaughan will introduce another discussion on "Deviation from the Normal Course of Sexual Reproduction in Plants," on which Dr K Blackburn and Dr M Knight also will speak Recent work has shown that apogamy is of such common occurrence in the plant kingdom that it is time again to take stock of the position

Most branches of botany will be well represented in other parts of the programme, including physiology, genetics, cytology, plant pathology, morphology, palæobotany and systematic botany

The popular lecture this year will be given by Dr D H Scott, who will take as his subject "The Transformations of the Plant World in Geological Time" A full programme of excursions has been arranged

SECTION L (EDUCATIONAL SCIENCE)

On August 27 Section L (Education) opens its annual meeting under the presidency of Dr W W Vaughan, headmaster of Rugby, with a discussion on "The Training of Teachers" Although inspired by the recent Government report, the discussion is expected to include the training of teachers for secondary schools as well as that for elementary school teachers

Public attention is to be directed to those conditions of boarding-school dietary (institutional feeding), which experience has shown to be necessary for the health of the growing child It is hoped to arouse general interest in the need for more careful attention to the many factors involved other than those of cost and calorific value of foods

The disciplinary value of subjects taught in schools is to form the theme of a discussion immediately following the president's address on "The Warp and Woof of Education" Later on in the session a strong attack is to be made on those schemes of school science that do not include the study of living things the biologist and zoologists are combining to represent the urgent need of a broader basis for science teaching than exists in the majority of schools,

in order to emphasise the educational value of a study of animal life as well as that of botany

The psychologists and educationists, led by such practical observers as Prof Cyril Burt and Messrs Cox, Earle, and Salter Davies, are meeting in joint session to hear and discuss the latest results of research on vocational guidance The education of the industrial worker and expert will be reviewed by Sir Robert Blair, who will open a discussion on "The Conditions of Success of Technical Institutions" Mr Wickham Murray will deal with the handicap imposed by the present narrow spirit of university matriculation requirements on technical students, and Dr W M Varley will speak for the claims of the "Local College" as a centre of educational activities for adolescents and adults, providing not only technical instruction but also opportunities of wide cultural study

A lecture will be given by Dr Ernest Barker on "Growth of National Character," and another by Mr Percy Scholes on 'Musical Education by means of Player-piano, Wireless, and Gramophone"

Catalysis and Oxidation [1]

By Prof HENRY E ARMSTRONG, F R S

THE treatment of the subject must depend upon the definition that is given of the term Is or is not *catalysis* to be regarded as the synonym of *chemical change in general*? Berzelius, the author (1835) of the term, who developed the conception, included among catalysts agents so diverse as sulphuric acid (*e g* the production of ether and the hydrolysis of starch), platinum, especially in the spongy form (*e g* the formation of water from hydrogen and oxygen and the oxidation of alcohol), and enzymes (*e g* the hydrolysis of starch by diastase) Such agents have, in common, the power of acting reversibly, so that they may eventually be recovered, if not soiled by some secondary change

The need of a clear definition and limitation is obvious from the frequent use of the expression *contact catalysis*, as if there were several forms of catalysis Such use of the adjective *contact* is superfluous, to say the least—as all chemical interactions necessarily involve *contact* of the substances concerned, whatever their character if the expression have any meaning, it can only be that of chemical change in general, for which we need no other specific term

I would urge that the term catalysis be limited to actions *at* and *influenced by solid surfaces* in other words, the catalyst is either an extended solid surface or a finely divided, particulate agent—in suspension, not in solution I have specially developed this view in my recent Messel Lecture to the Society of Chemical Industry (Journal, 1922)

Since 1885, my contention has always been that chemical change is an electrolytic process On this assumption, whilst electrolytes, in solution, may interact directly, chemical action between non-electrolytes is an indirect process, determined by the presence of an electrolyte compatible with the substances ultimately brought into interaction through its agency, because of its power of linking them in a conducting circuit This agent I would term the *determinant*, it is necessarily an electrolyte

In general terms, the equation of interaction may be written

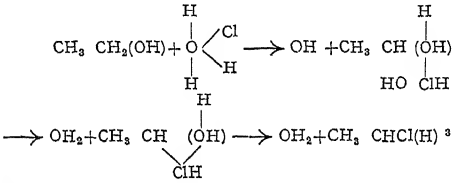
$$A_2+\epsilon\delta+B_2 \rightleftharpoons AB+AB+\epsilon\delta,$$

where $\epsilon\delta$ is the electrolytic determinant

I have specially considered the formation and nature of electrolytes in numerous communications to the Royal Society and elsewhere [2] To give a specific illustration alcohol and hydrogen chloride do not interact, except in the presence of water

$$\text{Et OH}+\text{HCl}=0$$
$$\text{Et OH}+\text{H}_2\text{O}=0$$

Hydrogen chloride and water together, however, form an electrolyte The process of interaction, in their presence in association (as a composite electrolyte), may be less direct and more complex than is commonly supposed perhaps broadly as follows



Having the postulate referred to above in mind, I was able, in 1885, to predict not merely that oxygen and hydrogen cannot interact but that water alone would not suffice as determinant—that the water must be impure, *i e* an electrolytic conductor The forecast has been verified by H B Baker The criterion is a simple one Over and over again, the correctness of this postulate has been verified experimentally, especially by H B Baker, whose masterly, long-continued inquiries are in no way appreciated as they should be It has led me to affirm that gases cannot interact—except in the presence of a liquid determinant, if not of a catalyst Aitken's work on the condensation of hydrone, $x\text{OH}_2$, to water, $(\text{OH}_2)_x$, may be interpreted from this point of view

At least the chief distinction to be drawn between changes influenced by catalysts and those which occur in a wholly liquid medium is, that whereas, in the latter, the extent to which change takes place diminishes as the concentration is diminished, in the presence of a catalyst the rate of change is constant over a considerable period and apparently independent of the concentration *in the solution* because of the attractive influence exercised by the catalyst and the consequent uniform and continued concentration of the hydrolyte at its surface

I have long thought—and the evidence in favour of the interpretation is increasing daily—that so-called gaseous interactions always take place at the surfaces with which the nominally interacting gases (plus the necessary determinant) are in contact—the surface playing the part of catalyst, by serving to attract and hold the determinant It may be questioned whether Moureu's refined studies of oxidation do not furnish complete evidence of this view In some instances the substances which he has successfully used as inhibitors of the oxidation of acrolein have been of such low volatility that they can scarcely have been present, except in most minute proportion, in the gas above the liquid if so, it may be legitimate to suppose that oxidation is confined to the liquid state All turns on the proportion of inhibitor that is necessary

We are not entirely clear, however, as to the function of the catalyst—whether or no it be included

[1] Address delivered at the second of the triennial conferences of the Institut International de Chimie Solvay on April 22

[2] Proc Roy Soc 1886, 40, 268, A, 78, 264, 1907, A 79, 586, 1908, A, 81, 80, 1910, A, 84, 1912, A, 86, 604, 1914, 90, 73 British Association Report, 1885 J Chem Soc, 1895 1122

[3] The H in brackets is that which may be supposed to take the place of (OH) originally in the alcohol Some such process as this may be at the root of the Walden inversion

in the circuit or whether it merely serve to attract and hold the determinant, together with the substances the interaction of which it determines Taking the case of hydrogen and oxygen interacting at a platinum surface, it is open to question whether the platinum be coupled with both gases at adjacent points, the determinant acting as an electrolytic conductor between the two, or whether the determinant be merely adherent to and concentrated upon the platinum the two gases being attracted to it thus forming the circuit within which change takes place

The balance of evidence would seem to be in favour of the former explanation Thus, platinum influences the interaction of hydrogen and oxygen but not that of carbonic oxide and oxygen Carbonic oxide and various hydrocarbon vapours even have a protective and preventive action and *apparently* can displace both oxygen and hydrogen from a platinum surface It might be that carbonic oxide is also more attracted by the liquid determinant It is almost impossible to grant that any one of the gases can monopolise the surface The behaviour of carbonic oxide, in fact, is in many respects peculiar and needs special discussion

Evidence on the point is, perhaps, to be found in recent observations on the interaction of hydrogen and oxygen in presence of silver and gold (D L Chapman, J E Ramsbotton and G G Trotman, Proc Roy Soc A, 197, 92) Bone and Wheeler have shown that both metals are more active after heating in hydrogen but not if heated in oxygen Chapman and his fellow-workers show that absorbed oxygen acts as an inhibitor, apparently owing to the formation of a film of metallic oxide, whilst absorbed hydrogen does not appreciably diminish or increase the activity of the metal They have further found that the two gases interact, even at the laboratory temperature, in the presence of a silver film deposited on the inner surface of the vessel in which they are confined The explanation of the inhibiting effect of the film of oxide may be that, being strongly alkaline, the film holds the *trace of acid* which normally serves as electrolytic determinant Whether silver act as the catalyst and determine interaction at ordinary temperatures—because it merely attracts the electrolytic determinant and the two gases to its surface—or because either or both of these is absorbed by it, must apparently be left an open question

The special activity of catalysts, due to their particulate character, may be ascribed to the influence they exercise in maintaining a high "surface concentration" of the interacting substances On this account, the primary action exercised by the enzyme takes place during the earlier, in fact, a considerable period, at a linear rate, only as the products of change accumulate and the action is reversed to an appreciable extent or the enzyme is neutralised or lamed by products of change is the rate of change perceptibly diminished This is well illustrated by curves showing how urea is hydrolysed by urease, according as the product of change, ammonia (which but lames the enzyme, as the action is not sensibly reversible), be allowed to accumulate or be neutralised by an acid too weak to affect the enzyme

Enzymes have a peculiar and rigidly *selective* activity—it is on this account that they form a special class of catalyst They, therefore, influence the hydrolysis of specific hydrolytes, there is no reason to regard their hydrolytic influence as exercised in any peculiar manner

To make the argument clear, it may be well to recapitulate and consider the formation of hydrone from hydrogen and oxygen Being non-conductors, by my postulate above, these gases cannot interact

$$2\mathrm{H} + \mathrm{O} = 0$$

By this same postulate, even the presence of "water" would not suffice

$$2\mathrm{H} + (\mathrm{OH_2})x + \mathrm{O} = 0$$

Action would only take place in the presence of an electrolytic determinant

$$2\mathrm{H} + \epsilon\delta \mid \mathrm{O} = 2\mathrm{H_2O} + \epsilon\delta$$

As however, the determinant would only be an electrolyte if present as liquid, and moreover as the formation of liquid appears to be dependent upon the presence of a nucleus, *i e* of a surface it is conceivable that no change would take place unless a catalyst (*k*) were present

$$2\mathrm{H} + \epsilon\delta k + \mathrm{O_2} = 2\mathrm{H\ O} + \epsilon\delta k$$

Finally, as interaction takes place in an electrolytic circuit, hydrogen is but indirectly "oxidised" whilst oxygen is hydrogenised

$$\begin{matrix}\mathrm{H}\\|\\\mathrm{H}\end{matrix} + \begin{matrix}\mathrm{HO}\\ \\\mathrm{HO}\end{matrix} \qquad \begin{matrix}\mathrm{H}\\ \\\mathrm{H}\end{matrix} + \begin{matrix}\mathrm{O}\\|\\\mathrm{O}\end{matrix} = \begin{matrix}\mathrm{H\ O}\\ \\\mathrm{H\ O}\end{matrix} + \qquad + \begin{matrix}\mathrm{HO}\\|\\\mathrm{HO}\end{matrix}$$

As this illustration shows, oxidation is not a direct but an indirect, *depolarising* effect

It may be questioned whether water itself, as liquid, should not rank as a catalyst In the interactions considered, it appears only as part of the electrolytic determinant and is necessarily to be thought of as present in the liquid state Supposing, however, that in an entirely gaseous mixture—say, under the influence of an electric discharge—a sufficient number of hydrone molecules were temporarily brought into conjunction and formed liquid drops, would these suffice to determine interaction independently of any solid surface? It is possible that they would, *if* drops were formed under such conditions The water, however, would not then be acting as catalyst but merely as part of the determinant the rate of change would not be raised, as it is by solid catalysts

The argument may be extended to the reverse process—the electrolysis of acidified water between platinum electrodes—and the assumption made that the perhydrone produced during the first stage,

$$\begin{matrix}\mathrm{H} & \mathrm{OH}\\ \mathrm{H} & \mathrm{OH}\end{matrix} \longrightarrow \begin{matrix}\mathrm{H}\\ \mathrm{H}\end{matrix} + \quad + \begin{matrix}\mathrm{HO}\\ \mathrm{HO}\end{matrix}$$

is itself acted upon and hydroxylated during the second

$$\begin{matrix}\mathrm{H} & \mathrm{OH}\\ \mathrm{H} & \mathrm{OH}\end{matrix} + \begin{matrix}\mathrm{HO}\\ \mathrm{HO}\end{matrix} \longrightarrow \begin{matrix}\mathrm{H}\\ \mathrm{H}\end{matrix} + \quad + \begin{matrix} & \mathrm{H}\\ \mathrm{HO} & \mathrm{O}\end{matrix}\!\!>\!\mathrm{O} + \mathrm{H\ O}$$

The "oxoperhydrone" thus formed is then hydrolysed into oxygen and hydrone, being itself acted upon perhaps, as a composite electrolyte

$$\mathrm{H\ O\ O\ O} \qquad \mathrm{H{+}HO} \qquad \mathrm{H} \longrightarrow \mathrm{H\ O} + \mathrm{O} + \mathrm{H\ O}$$

If the electromotive force or the current density be increased and the rapidity of attack sufficiently raised, the "oxoperhydrone" may be further hydroxylysed

$$\begin{matrix}\mathrm{H} & \mathrm{OH}\\ \mathrm{H} & \mathrm{OH}\end{matrix} + \begin{matrix} & \mathrm{H}\\ \mathrm{HO} & \mathrm{O}\end{matrix}\!\!>\!\mathrm{O} \longrightarrow \mathrm{H_2} + \begin{matrix}\mathrm{HO\ \ O}\\ \mathrm{HO\ \ O}\end{matrix} + \mathrm{H\ O}$$

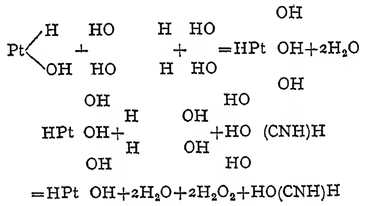
Ozone may be pictured as formed by the hydrolysis of a "dioxoperhydrone" (also, perhaps, in the form of a composite electrolyte) thus produced

$$\begin{matrix}\mathrm{H}\\ \updownarrow\\ \mathrm{HO}\end{matrix} \quad \mathrm{O\ O\ O} \quad \begin{matrix}\mathrm{OH}\\ \updownarrow\\ \mathrm{H}\end{matrix} = \mathrm{H_2O} + \mathrm{O_3} + \mathrm{H_2O}$$

In like manner, when concentrated solutions, particularly of sulphuric acid, are electrolysed, peracids are formed, which, in turn, according to the conditions, give rise to perhydrone, to oxygen or to ozone when hydrolysed

Oxidation phenomena in general may be interpreted in a similar manner

The suspended or inhibited oxidations which Moureu and his fellow-workers have studied so thoroughly in recent years, seem to be consistently accounted for by regarding them as involving the continued backward and forward hydroxylation of competing or antagonistic oxidisable compounds—*i e* as interference or reversal effects I have long thought of the inhibition by hydrogen cyanide of the decomposition of perhydrone by platinum or yeast as due to the formation, in the first instance, of perhydrols and their reversible interaction



In result, the interactions here pictured have the same effect as those postulated by Moureu, the main difference being that the process is more clearly defined, as it is represented as "electrolytic" in all its stages Moureu has usually assumed that the substance primarily concerned is oxidised to a "peroxide," $A(O_2)$, from which oxygen is transferred to the inhibitor, a second "peroxide" $B(O)$ being formed, the primary "peroxide" being reduced to another "peroxide," $A(O)$ the original molecules are reproduced by the interaction of these antagonistic "peroxides"

$$A+O_2=A(O_2) \quad A(O_2)+B=A(O)+B(O)$$
$$A(O)+B(O)=A+B+O$$

In their recent communication to the Chemical Society, however, Moureu and Dufraisse clearly contemplate the probability that platinum, acting as an oxygen carrier, oxidises the molecules of hydrogen and the interfering gas (H_2, CO, C_2H_4, etc) simultaneously to form two antagonistic peroxides, which then interact, reducing each other

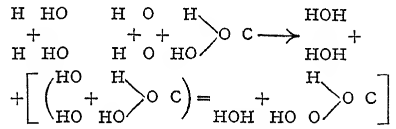
The oxidation of the two oxidisable substances is and, indeed, must be effected in the same circuit, one of them acting as "depolariser," thereby raising the potential to the necessary extent otherwise, one would not be oxidised at all or the "antagonism" would be incomplete

Carbonic oxide may be taken in illustration I have long wondered at the peculiar behaviour of this gas, in fact since I first read in the early 'seventies Groves' fascinating memoir on his gas battery and Faraday's earlier more complete observations on the combining power of platinum, in the former it is shown that carbonic oxide cannot be coupled with oxygen, as hydrogen can, to form a gas battery Then came H B Dixon's discovery of the incombustibility of the dry gas and the increase in velocity of the explosive wave as the proportion of steam present was raised up to a certain maximum I have more than once discussed the problem, particularly in 1904, in a brief communication to the Royal Society on "The Retardation of Combustion by Oxygen" (Proc Roy Soc, 74, 86), in which I dealt with H B Dixon's observations on the retardation of the combustion of hydrogen by "excess" of oxygen and of Bone and Stocking's similar observations on ethane

Accepting the postulate at the root of the argument in this essay, inasmuch as the oxidation of carbonic oxide is a process involving the electrolysis of water,

$$CO+\begin{matrix}HO\\HO\end{matrix}\quad\begin{matrix}H & O\\H & O\end{matrix},$$

action should not take place at a platinum surface, at ordinary temperatures, because the heat of oxidation of carbonic oxide is below that of hydrogen the change would be endothermic Probably, the combustion of carbonic oxide is never a direct effect but is determined by a minute quantity of hydrogen, acting as adjuvant, produced initially when the combustible mixture is inflamed or sparked



To repeat what I said in 1904, "It is necessary to remember, that whereas both oxygen and water molecules diminish in stability as the temperature rises, the stability of hydrogen peroxide must be at a maximum at a high temperature—since its formation from oxygen and water is an endothermic process In fact, it is to be supposed that water is readily oxidised at temperatures such as prevail in combustions If, however, the formation of water be regarded as involving the changes

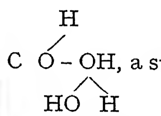
$$\begin{matrix}H & HOH & O\\ + & + & \\ H & HOH & O\end{matrix} \rightleftarrows \begin{matrix}HOH & HO\\ & +\\ HOH & HO\end{matrix}$$
$$2H_2O_2 \rightleftarrows 2H\,O+O\ ,$$

it follows that water and oxygen will mutually hold each other in check so that when electrolytic gas is exploded there will be a deficiency of oxygen, as it were, owing to its conversion into hydrogen peroxide, which may be regarded as relatively if not entirely inoperative as an oxidising agent, at high temperatures, in presence of oxygen On the other hand, when excess of oxygen is present, the water—which is the effective catalyst—will be more or less held back, also in consequence of its oxidation to hydrogen peroxide"

Whether or no the changes pictured above could equally well take place at a cold platinum surface would be open to question, were it not that platinum is known to determine the interaction of hydrogen and oxygen There is no reason to suppose that carbonic oxide could not enter the circuit of change, as a depolariser, under such conditions The difference in behaviour at low and high temperatures is, therefore, probably the consequence of differences in the stability of some of the compounds concerned

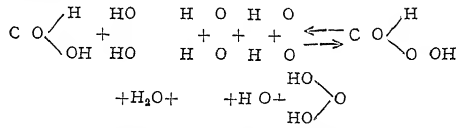
As to the form in which carbonic oxide primarily enters into the circuit of change, it is not unlikely that it is as the hydrol $C\ O\langle{}^{H}_{OH}$ rather than as formic acid Obviously, such a compound would be of low stability and the need of a high proportion of steam, to secure the combustion of carbonic oxide at the maximum rate, may be accounted for by the assumption that the presence of this hydrol, in sufficient proportion, is only to be secured in this way

The immediate product of the hydroxylation of the hydrol, $C\ O\langle{}^{H}_{OH}$, would be the "perhydrol"



a still less stable compound At ordinary temperatures, at a platinum surface immersed in an atmosphere of hydrogen, carbonic oxide and hydrone, this perhydrol would be antagonised by a corresponding "hydroxyperhydrone" or "oxoperhydrol" and

the two would interact reversibly to their mutual destruction.



At high temperatures, such perhydrols would no longer be formed and the direct combustion of the carbonic oxide with the aid of hydrogen, acting as depolariser would be effected without their interference and with special readiness.

One other case of apparently anomalous protection against oxidation may be referred to—that afforded by so-called rustless steel and the more recently introduced soft alloy staybrite. The former is a chromium steel, the latter an alloy of iron, nickel and chromium, as free as possible from impurities. That chromic acid will protect iron against oxidation is well known. It may be supposed that, in an alloy of iron with chromium, in which the chromium is properly distributed, both materials undergo surface oxidation to perhydrols which act reversibly, so that at most a layer of molecular thickness is affected, a coating being formed which may well correspond with the (?) unimolecular layer of oxide upon the surface of the far more sensitive metal aluminium.

It is permissible to suggest that the influence of certain dyestuffs in checking the "fogging" of an undeveloped photographic plate may perhaps be traceable to the initial production of antagonistic perhydrols by simultaneous hydroxylation of the sensitive film and the coloured material.

Finally some reference to the oxidases may not be out of place. These are commonly spoken of as enzymes but they are in no way comparable with these in so far as they act selectively. They are only selective in the broad sense that they are effective agents in determining the oxidation of compounds of a particular general type. Thus so called tyrosinase will determine the oxidation of phenolic compounds of a certain type—not of tyrosin alone. This is true of "oxidising" organisms, such as *Bacterium aceti* and *B. xylinum*. The behaviour of *B. aceti* is altogether peculiar—although active towards ethylic and normal propylic alcohols it has no action upon either methylic or isopropylic alcohol. At present we know so little of the process at work that it is impossible to attempt any precise explanation of these peculiarities. It may be suggested, however, that they are traceable both to configurational and energy differences in the systems concerned: moreover, it is clear that something more than the simple, direct oxidation of the alcohol is to be contemplated and that cross-interactions may be at work. Maybe we shall have little success in interpreting such actions until we no longer think "on paper" but have clear conceptions of the solid configuration of molecules. The oxidases may well be discarded from the class of enzymes and regarded as simple catalysts—of a parity with platinum black.

Not a few mysterious processes may be open to interpretation in accordance with the principle developed in this essay. The peculiar behaviour of phosphorus is a case in point—especially the dependence of the appearance of luminosity upon the partial pressure of the oxygen and the phenomena of intermittent luminosity to which Lord Rayleigh has recently directed attention. Little can be said with advantage, however, until we know far more of the several stages of the oxidation process—which may well be as complex as that of the interaction of nitric acid and metals.

Genetical Investigations

THE practical value of chromosome studies is perhaps nowhere better demonstrated than in the wheats, where the species belonging in different groups have different multiples of 7 as their chromosome number. In hybrids between species with different numbers of chromosomes, the peculiarities in the hybrid behaviour are largely explained by the history of the chromosomes, some of which pair in meiosis while others remain single.

Sax and Gaines [1] draw several conclusions from a study of hybrids between emmer wheats (28 chromosomes) and vulgare wheats (42 chromosomes), which have been grown through several generations. The various segregates tend ultimately to have the same chromosome numbers as the original parents. This is accomplished through sterility or loss of chromosomes in forms with intermediate numbers, as has been found also in the Œnotheras and in other cases. Segregates with 28 chromosomes resemble the emmer wheats, while those with 42 have most of the vulgare characters. This indicates that the 7 extra pairs of chromosomes determine most of the vulgare characters. The chromosome behaviour would lead to the expectation that ordinary Mendelian segregation would occur in characters, such as presence or absence of awns, yellow or black awns, and red or white grain, which are common to both the emmer and vulgare groups of wheats, while aberrant segregation would occur in regard to characters which distinguish the two groups. This is largely borne out by the results of experiment. Some of the segregates show combinations of typical emmer and vulgare characters which indicates that the 7 unpaired chromosomes (which are irregularly distributed in meiosis) independently determine particular characters of the vulgare group.

Another interesting result, obtained by Mr. and Mrs. Sax,[2] is derived from a cross between *Ægilops cylindrica*, a grass found in Italy, the Balkans, and neighbouring countries, and Marquis wheat, one of the most productive varieties of *Triticum vulgare*. Ægilops, like the emmer wheats, is tetraploid, having 28 chromosomes. The F_1 hybrid with *T. vulgare* is pentaploid (35), but unlike the crosses between tetraploid and hexaploid wheats, there are only 6 or 7 bivalents in meiosis (instead of 14), the remaining 21 chromosomes remaining univalent or unpaired. Nevertheless, the tetrad divisions are run through with very few irregularities, some of the univalent chromosomes apparently dividing in the first meiotic division while others divide in the second. The F_1 hybrids are in general intermediate between the parents, and are almost but not completely sterile.

The authors point out that this species of Ægilops and another both contain all the characters which distinguish the vulgare from the emmer wheats, and they suggest that the hexaploid vulgare wheats may have arisen through a spontaneous cross between Ægilops and a tetraploid (emmer) wheat. Irregular distribution of the unpaired chromosomes, of which there would probably be 14, would occasionally

[1] Sax, Karl, and Gaines, E. F., 1924. A Genetic and Cytological Study of certain Hybrids of Wheat Species. *Journ. Agric. Research*, 28: 1017-1032, pls. 2.

[2] Sax, K., and H. J., 1924. 'Chromosome Behaviour in a Genus Cross.' *Genetics*, 9: 454-464, pls. 2.

produce a gamete with 21 chromosomes The union of two such gametes if the chromosomes were balanced in qualities as well as in numbers, might have produced the first of the hexaploid wheats Thus is crossing combined with chromosome aberrations made the basis for a theory of the origin of our cultivated wheats

Contributions continue to be made to the study of size inheritance The prevalent interpretation is that size in organisms and in their parts is controlled by cumulative polymeric size factors the various increments of which give the appearance of a continuous series Much evidence is appearing in favour of this view Sax[3] has recently, from experiments with beans, found evidence of linkage between certain seed-coat colour patterns and certain factors for size of seed Cases have even been found in which a factor for large size was contributed by the small parent Such a result might occur if the small parent contained a few factors for large in addition to a number which made for small size

Closely related to size-inheritance are the problems of shape The work with animals indicates that some size factors may affect the body as a whole while others independently determine the size of particular organs These conceptions have already been applied by Davenport to man, and in a recent contribution[4] he considers the inheritance of body build He recognises five classes of build, ranging from very slender to very fleshy Two slender individuals usually have only slender children, while the progeny of fleshy individuals are much more variable Such data lead again to the hypothesis of multiple factors, and it is believed that in some families so many as three genetic factors for increasing fleshiness are present These factors are thought of as influencing size by the effect they have upon the activity of the thyroid, pituitary, and other endocrine glands

Similar conceptions are being applied by Frets, Hilden, and others to the inheritance of head-shape Thus it appears that several factors for broader head may change a dolichocephalic to a brachycephalic skull Thus genetics is destined to have a fundamental effect upon the interpretations of anthropologists R RUGGLES GATES

[3] Sax, K 1924, ' The Nature of Size Inheritance Proc Nat Acad Sci, 10 224 227

[4] Davenport, C B, 1925 Body build its Development and Inheritance Eugenics Record Office, Bull No 24 pp 42, figs 25

The Carbonisation of Coal

THE Chemical Engineering Group of the Society of Chemical Industry met on July 16 at the forty-fourth annual meeting of the Society at Leeds Three important papers on features of coal carbonisation were read before a crowded audience, and the discussion had to be adjourned to another session proposed to be held in Leeds in the autumn Solid fuels were dealt with in two papers "Smokeless Fuels—the Present and Future Possibilities," by C H Lander and Margaret Fishenden, and "Solid Smokeless Fuels' by E C Evans In the former paper the British fuel situation was analysed, particularly with the view of estimating the possibility of establishing new carbonising industries If all coal were to be pre-carbonised, the disposal of gas and tar would become considerable problems If domestic fuel only were to be carbonised this difficulty would be much less, but it was considered that a coke of much more suitable character than that currently produced in gas works would be required The domestic fuel market is the most promising outlet for carbonised fuel of suitable character It was concluded that the most suitable carbonisation process to meet this need cannot be defined with certainty The solution of the problem may prove to be not in any single method of carbonisation but in several, each operating in circumstances most favourable to its requirements

E C Evans gave a classification of smokeless fuels, directing attention to the properties of anthracite, for which there is a steady demand even to-day, in spite of its high price This points a moral to those desirous of introducing carbonised domestic fuel Gas coke he considered as far short of the ideal, particularly because of its high ash and moisture content The reactivity of coke was treated at length, and the factors influencing it were analysed Methods of low temperature carbonisation were discussed In summing up, Evans thinks that low and high temperature systems are approaching one another, and that ultimately a compromise will establish itself In the discussion it was significant that, in so representative an assembly of fuel technologists, no one could be found to assert confidently the commercial feasibility of existing methods of low temperature carbonisation which figures so prominently in the Press and on the platform

F S Sinnatt and J G King brought forward a study of the tars and oils from coal From an analysis of the economics of mineral oils and coal tars, they drew the conclusion that the prices obtainable for low temperature tars would so far as present promise goes, be low and liable to great fluctuation The calorific value of such tar is low and the difficult miscibility with mineral fuel oil is a limitation This is not necessarily fatal for the Lessing process for separating the pitch-giving constituents, now under trial at the Fuel Research Station, shows considerable promise Some account of these results was given The limited knowledge of the chemistry of low temperature tar was emphasised, and it was suggested that organic chemists should take up the study of its properties The production of liquid fuel from coal either by hydrogenation of the coal or of the gasified product was also discussed

University and Educational Intelligence

"INFORMATION regarding courses and careers open to students of science' proposing to enter the Faculty of Science of the University College, Cardiff, is given in a little pamphlet issued this year for the first time by the College authorities It follows the lines of the similar pamphlet issued by the University of Birmingham last year and represents a commendable anxiety on the part of the College to acquaint parents, guardians, and heads of schools with the opportunities it offers, so that the last year or two at school of those intending to go on to college may be utilised to the best advantage

FROM the Royal Technical College, Glasgow, and the Merchant Venturers' Technical College Bristol, we have received prospectuses for 1925–26 The former which is the only institution in Great Britain providing regular courses in the technology of sugar manufacture, announces that to meet the requirements of the beet sugar industry, the lectures in this subject will begin in January and will extend over the summer session Both Colleges give lists of the engineering firms which offer facilities to students for acquiring practical experience in their works The Merchant Venturers' College offer, as alternative courses for the degree of B Sc in engineering, a

continuous 3-years course, a 5-years' course of evening class work, and the Bristol sandwich system which interposes practical training in a works for 14 months between the first and second sessions of academic work, for two summer months between the second and third sessions, and finishes with practical work for 14 months after the third session Loughborough College on the other hand claims in its Calendar for 1925–26 to have found a better way of training by providing facilities for all necessary practical work in its own workshops so that the theoretical work in the College may be made to keep step with the workshop training

HONOURS courses in American universities and colleges are described by President Aydelotte of Swarthmore College Pennsylvania in a report recently published (Bulletin No 52 of April 1925) by the National Research Council of America So vigorous is the movement in the United States for liberalising higher education by the introduction of honours courses more or less like those open to students in English universities, that the number of institutions offering such honours work has doubled since the publication in January 1924 of the first edition of this report, when the number was about 46 The character of the movement is determined by the recognition of two principles which are regarded as the foundation of the success of the English honours system the frank distinction between students who are really interested in the intellectual life and those who are not, and the recognition of the necessity of allowing the former more responsibility for working out their own intellectual salvation President Aydelotte is careful to point out in concluding his report that ' the system now being introduced need not mean any curtailment of the quality of teaching enjoyed by the average student What our best students need is not coddling not more attention, not more teaching, but only greater freedom and more severe requirements "

IN the report for the session 1923–24 of the Department of Coal Gas and Fuel Industries of the University of Leeds the Livesey professor remarks that whilst the Department is developing satisfactorily so far as post-graduate work is concerned, the supply of students taking the normal three or four years' course of training in fuel, leading to a degree or diploma granted by the University, is inadequate to meet the demands of the fuel industries for trained fuel technologists The University requires a steady supply of students whose numbers may be depended upon from year to year, rather than any large increase in their number Laboratory facilities at the disposal of the Department are at present inadequate to enable students of mechanical, civil, and electrical engineering to obtain desirable training in fuel technology and metallurgy Through the generosity of Mr Henry Woodall, and a number of gas companies and other industrial concerns, an experimental coal gas plant has been presented to the University, and has been employed in work carried out for the Gas Investigation Committee of the University and the Institution of Gas Engineers Research work carried out in the Department relates to the influence of ash constituents in coal on the carbonisation process, the scaling of metals the hardness of metals as affected by grain size, the transformation of quartz during the process of manufacture of silica bricks metallic coatings resistant to oxidation at high temperatures gas purification, the thermal expansion of metals and alloys and the changes occurring on heating clays, bauxites, etc the aeration of gas jets, and heat recovery by waste-heat boilers

Early Science at Oxford

August 26, 1684 Dr Plot, lately come from ye Royall Society, informes us, that in a meeting of that Society on some day in this month he saw a handkercheif, made of Salamanders Wool or *Linum Asbesti* shewn ye Royall Society by a merchant who lately brought it from China To try whether it was genuin, or no it was put into a strong charcoal fire, in which not being injured it was taken out, oiled and put in again, ye oil being burnt off, the handkercheif was taken out again and was altered onely in two respects it lost two drachms and five grains of its weight, and was (as ye merchant affirmed) more brittle then ordinary for which reason it was not handled untill it was grown cold, by which time it had recovered its former tenacity and in a great measure its weight

The merchant who oblidged ye Society with ye sight of so great a Rarity acquainted them, that he received it from a Tartar who told him, that the Tartars among whom this sort of cloth is sold at £80 sterling for a China Ell, (which is less than our Ell,) use this cloth in burning ye bodyes (to preserve ye ashes) of great persons and that in Tartary it is said to be made of ye root of a tree The thread of it was (as ye Doctor affirms) very large

He also acquainted us, that it haveing formerly been queried in ye Royal Society in London whether ye Air contained in ye spirit within a thermometer, be not some cause of the ascent of that spirit in hot weather

This quære was resolv d by ye following experiment a little Siphon was made to reach from ye top of the thermometer, to the receiver of Mr Boyl s pump ye air in the thermometer was drawn out, after which a warm hand being applyed to it ye spirit did *still* rise

The observations of Mr Bullialdus Mr Cassini, and Mr Jacobs at Lisbon concerning ye last solar Eclipse, were presented our Society, and compared with those made here at Oxon, and at Greenwich

Mr Boyle's booke of ye Porosity of Bodyes was communicated to our Society

A Letter from Mr Robert Spear to Dr Wallis, dated from Port Royall in Jamaica, May 10, 1684, was read it mention d a Booke lately printed at Boston, in New England, entituled *An Essay for the Recording of Illustrious Providences*, in which, among other relations, there is an account of ye poles of some needles of Sea-compasses being burnd by thunder and lightning, near New England it is almost verbatim with the account of the same thing mention'd in ye Philosophical Transactions no 157

Dr Plot shewed us some of ye *Risagone Ind*, or Cassumminiar a root found on ye mountains 24 gr Lat about Patmia near Bengal Snow will not lye over it long, 'tis of very thin parts, bound up in an earthy matter, us'd in many disseases of ye head and nerves, and in dysenteryes, being ground to powder, and given in common water a decoction of it is made in ye same manner as coffee

The Doctor tells us, as he is inform'd by good hands, that Mr Hugh Percy of Weymouth has enquired into ye nature of ye current at ye Streights mouth, by letting fall a bucket, and a weight with it, and that he found his bucket constantly carried outwards, it is to be wished that Mr Percy be desired to give his own account of what he has done in this kind

September 2, 1684 There being no great appearance of company, all business was deferred to some fuller meeting

Societies and Academies.

CALCUTTA

Asiatic Society of Bengal, July 6 —Braja Lal **Mukherjee** The Vrātyas and their sacrifices Vrātyastoma is a social or religious penance for those who have in some manner or other defied or neglected religious law and order Men originally belonging to the Vaidik community, but becoming alienated, and neglecting or defying Vaidik precepts, and creating disorder, were called Vrātyas —Bimala Charan **Law** Data from the Sumangalavilāsinī An attempt has been made to present from the Sumangalavilāsinī (the commentary on the Dīgha Nikāya of the Sutta Pitaka, written by Buddhaghosa), interesting materials for the study of ancient Indian life

SYDNEY

Linnean Society of New South Wales, May 27 —May M **Williams** Contribution to the cytology and phylogeny of the siphonaceous Algæ (1) The cytology of the gametangia of *Codium tomentosum* In the nuclear divisions occurring in the cœnocytic threads of the vegetative parts of the plant, twenty univalent chromosomes are present Reduction division occurs in the gametangium as the result of two nuclear divisions which occur there Certain of the nuclei present in the young gametangium degenerate before these divisions occur The selection of functional nuclei is associated with the presence of bodies of the nature of cœnocentra within the gametangium —H **Burrell** Burrowing habits of Ornithorhynchus A Platypus (usually the female), in excavating its burrow, will, if necessary, lie on its back to work Its muscular and mobile movements are described, particularly with reference to the work of the hind feet, which have a 'two-way' action, and are as versatile as those of a chimpanzee The functions of the hind and front legs are interchangeable —J R **Malloch** Notes on Australian Diptera No vi —G D **Osborne** Geology and petrography of the Clarencetown-Paterson District Part iv The petrographical account of the Kuttung igneous rocks is divided into (*a*) a general discussion of such matters as the sequence of flows and their mutual relationships, and the presence of devitrification, of spherulitic structures, and in particular of evidence which has been interpreted as indicative of the operation in some rocks, after consolidation, of processes connected with the magmas from which these rocks were derived, (*b*) a petrographical description of the rocks, taken in groups

Royal Society of New South Wales, July 1 —H Leighton **Kesteven** (1) A third contribution on the homologies of the parasphenoid, ectopterygoid, and pterygoid bones, and of the metapterygoid (2) The parabasal canal and the nerve foramina and canals in the bird skull The application of Gaupp s designation "parabasal" to the carotid canal and the demonstration of the course of the palatine branch of the facial nerve serve to emphasise resemblances to the reptilian conditions —A R **Penfold** Note on the identity of uncineol with eudesmol Uncineol ($C_{10}H_{18}O$, $[a]_D$ 20° C +36 99°, melting-point, 72 5° C) is an alcohol which appears to bear a close resemblance to one of the terpineols, isolated in 1907 by Messrs Baker and Smith from the essential oil of *Melaleuca uncinata* The more recent investigation has shown this substance to be identical with the sesquiterpene alcohol eudesmol The chemical and physical characters are Melting-point, 80 5°-81° C, boiling-point, 155-156° C at 10 mm, specific rotation, +33 45°, molecular weight determinations, 221 and 227, molecular formula (combustion results), $C_{15}H_{26}O$, melting-point of dihydrochloride, 75-76° C —Sir George **Knibbs** Multiple births, their characteristics and laws mathematically considered Considering the question of masculinity of population generally, of live-births, and of the still-born, it is shown that the preponderance of males is most marked in the last, being about 21 9 per cent greater than that of live-births In Australia, as the masculinity of the general population decreases, that of the live-births increases Applying the theory of probability to the occurrence of twins, about 76 per cent of the cases are from two ova, and about 24 per cent from one ovum In the latter case the pair may be either both male or both female and have a common chorion while twins born from two ova are indifferently male and female, two males, or two females and each has its separate chorion Only about 10 9 per cent of triplets are from three ova, while in 69 1 per cent there is a division of one of the ova into two There is an increase of the liability of twins with the age of the mother each year from 12 years to 39 years, when it diminishes nearly by the same amount each year of age, until it becomes nothing at age 54 This greater liability with age to twins increases with the duration of marriage and with the number of previous confinements

Diary of Societies

WEDNESDAY, AUGUST 26

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE (at Southampton), at 8 30 P M —Prof H Lamb Presidential Address

THURSDAY, AUGUST 27

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE (at Southampton), at 10 A M —Prof W A Parks The Cultural Aspects in Geology (Presidential Address to Section C) —Sir Archibald Denny Fifty Years Evolution in Naval Architecture and Marine Engineering (Presidential Address to Section G) —Prof J Spearman Mental Law of Diminishing Returns (Presidential Address to Section J) —Prof J Lloyd Williams The Phæophyceæ and their Problems (Presidential Address to Section K) —At 11 30 A M —A R Hinks The Science and Art of Map making (Presidential Address to Section E) —At 2 —Conference of Delegates of Corresponding Societies —Address by Sir Daniel Hall President of the Conference —At 7 30 —Major A G Church Science and the East African Commission (Citizens Lecture)

FRIDAY, AUGUST 28

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE (at Southampton), at 10 A M —Dr G C Simpson The New Idea in Meteorology (Presidential Address to Section A) —C Tate Regan Organic Evolution Facts and Theories (Presidential Address to Section D) —Dr W W Vaughan The Warp and the Woof in Education (Presidential Address to Section L) —At 11 A M —Miss Lynda Grier The Meaning of Wages (Presidential Address to Section F) —At 11 30 A M —Dr T Ashby Practical Engineering in Ancient Rome (Presidential Address to Section H) —At 2 30 (Section I) —J E Barnard The Observation of the Infinitesimally Small (Lecture) —At 8 P M —A V Southwell Aeronautical Problems of the Past and of the Future (Discourse)

SATURDAY AUGUST 29

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE (at Southampton), at 3 —Dr F A Dixey Mimicry in relation to Geographical Distribution (Lecture for Young People) —At 8 —Prof E V Appleton The Role of the Atmosphere in Wireless Telegraphy (Citizens Lecture)

MONDAY, AUGUST 31

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE (at Southampton), at 10 A M —Prof C H Desch The Chemistry of Solids (Presidential Address to Section B) —Prof A V Hill The Physiological Basis of Athletic Records (Presidential Address to Section I) —Dr J B Orr The Inorganic Elements in Animal Nutrition (Presidential Address to Section M) —At 3 —W H Barker The Development of Southampton in relation to World Commerce (Lecture for Young People) —At 5 (Section K) —Dr D H Scott Some Points in the Geological History of Plants (Lecture) —At 8 —Capt P P Eckersley Some Technical Problems of Broadcasting (Citizens Lecture)

TUESDAY, SEPTEMBER 1

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE (at Southampton), at 3 —Prof W J Dakin Whaling in the Southern Ocean (Lecture for Young People) —At 8 —C J P Cave The Highway of the Air (Citizens Lecture)

WEDNESDAY, SEPTEMBER 2

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE (at Southampton)

NATURE

SATURDAY, AUGUST 29, 1925

CONTENTS

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The Coal Resources of Great Britain.

TO all sections of the community, the state of the coal mining industry in Great Britain is a source of great anxiety. The real difficulties which the industry has to face depend upon causes which are very deeply rooted. We were the first nation to develop our coal resources extensively and, owing to the fact that we had originally magnificent coal seams lying at no great depths, and above all, that our coal-fields lay close to the seaboard and within easy access of excellent harbours, we built up the magnificent coal trade upon which we justly pride ourselves. Coal, our main national asset, is unfortunately a wasting asset; once extracted it can never be replaced. At the present moment we are practically producing 23 per cent. of the world's coal output, whilst we have only $2\frac{1}{2}$ per cent. of the world's coal resources; in other words, we are drawing upon our coal reserves nine times as fast as the rest of the world, and these reserves are therefore gradually approaching extinction.

At the present moment, however, what we have to fear is not the exhaustion of our coal supplies so much as the increased cost of our coal production, which makes it impossible for us to compete with other nations for the coal trade of the world. This increase in price is no doubt to some extent due to natural causes, but to a far greater extent has been brought about artificially. Unless we can produce coal as cheaply as the nations with whom we are brought into competition, our coal trade, and with it the whole nation, must decline. The cost of coal production is made up of many items, into all of which wages enter to a greater or lesser extent, but direct wages make up about two-thirds of that cost. It depends, therefore, entirely upon labour whether our coal trade is to prosper or to suffer gradual annihilation. It must be emphasised in the strongest possible terms that this insistent demand for cheap production does not by any means necessarily imply low wages per man employed; it does require a low wages cost per ton of coal produced; in other words, the key to the situation lies in the maximum production per worker engaged in the industry.

In the United States of America, the cost of coal production is roughly two-thirds of what it is in Great Britain (12*s.* 8.4*d.* per ton as against 19*s.* 0.69*d.*), nevertheless, the men engaged earn much better wages, simply because the output per man is so much higher (3.82 tons per shift as against 0.928 ton). This fact is due in part beyond doubt to natural causes, but is also due to the fact that the men themselves work hard and that the Trade Unions have always opposed anything like a "ca' canny" policy. These same reasons furthermore help American collieries to develop extensively mechanical methods of machine mining. It is often overlooked that a severe limitation of the hours of labour, such as we have in Britain, prevents the extensive adoption of coal-cutting machines; these can only be used to advantage if they are kept actively employed. A colliery cannot afford to put capital into such machines if they are only to be worked six hours out of the twenty-four, and this consideration doubly handicaps our coal industry.

When the future of the industry comes to be considered, it may well be found that neither American nor German competition will prove so formidable as competition from China, India, and South Africa. The price of coal at the pit's mouth in these countries is only about one-third of our own, and their immense coal resources necessarily bring them into prominence in discussing the future of the British coal industry. It is true that we have the advantage of a well-established coal trade, which has developed as a natural consequence of so many of the British coalfields being so well situated geographically, and it is true that trade is loth to leave the channels in which it has been accustomed to flow. Certain of our labour leaders, however, by their continuously repeated threats of strikes, are demolishing that confidence in Britain's ability to supply the goods as and when customers require them, which formed the real basis of Britain's supremacy in the coal trade, and without which the maintenance of that trade is impossible. Once that South Africa has developed and organised suitable transport facilities and has built up for itself the trade which our internal dissensions have turned from us, our chance of competing is gone. Even now it is going; for some years past Natal has been competing successfully in the Bombay markets with British and Indian coals.

It seems impossible to avoid the conclusion that we cannot hope to regain the position which we once held, that of the world's chief manufacturers, as this was based essentially upon the fact that we were able to produce coal in any desired quantity more cheaply than could any of our competitors, and the question which to-day is the most insistent is whether anything can be done, if not to restore our lost supremacy, at any rate to find some new method of utilising our coal to advantage, so as to save us from national extinction.

The situation is reviewed in an interesting article by Mr. Lancelot Lawton on "Coal and the Future" in the August issue of the *Fortnightly Review*. With most of the views therein expressed the majority of serious students of the economics of the coal industry will cordially agree, although there are several points to which exception may be taken. Thus the author commences with the statement that "the critical condition of the British coal-mining industry is due to the fact that to a large extent thicker seams at moderate depths are being exhausted"; the fact of this exhaustion is sufficiently well known, but working at moderate and even considerable depths is to-day no longer a serious problem. With modern methods of engineering, the increase in the working cost of winning coal from deep-lying seams is negligible, as witness the fact that the only collieries in Britain that are working to-day under anything like satisfactory conditions are the deep pits in the concealed Yorkshire coalfield. The real crux in the working of deep seams lies in the vastly greater initial outlay required, but, once capital can be assured that it will get an adequate return for its employment in such a relatively risky undertaking, depths of even of a thousand yards can no longer be considered a real obstacle to economic working. It may fairly be said that in spite of the wild talk of Socialists, one of the serious problems that confronts the coal industry is how to inspire capitalists with this assurance; collieries inevitably become exhausted in the process of time, and if our coal trade is to be maintained, new pits must be sunk and new collieries opened out. Needless to say, this can only be done if the capitalist is assured that the investment involves only a fair business risk.

Like many others, Mr. Lawton pins his faith in the regeneration of the coal industry upon the general employment of low temperature carbonisation, with its attendant production of oil and other bye-products. Low temperature carbonisation is, however, by no means yet as assured of success as many seem to think, for they generally overlook not only the mechanical difficulties, but also the chemical difficulties which the process presents, such as are well indicated in the paper on the "Study of the Tars and Oils obtained from Coal," by Messrs. Sinnatt and King, read at Leeds at the recent meeting of the Chemical Engineering Group of the Society of Chemical Industry. Furthermore, there are other processes to be taken into account; it may fairly be said that for the production of oil from coal the Bergius process would seem to promise to rival, if not to surpass, low temperature carbonisation; the "Synthol process," based upon the interaction between carbonic oxide and hydrogen, also must not be left out of account, although this is not an industrial process to-day. Fischer, in his recent work on the conversion of coal into oil, translated by Lessing, says: "The Synthol Process, combined with primary tar production, likewise indicates the possibility of a total conversion, and indeed offers, in my opinion, the best promise for the future."

In view of these and many other possibilities which the scientific research of coal, now actively pursued in many quarters, is opening up, it is more than doubtful whether it would be a wise policy to-day to embark upon the construction of costly low-temperature carbonisation plants. A few years may well see this process relegated to the background and displaced by some more profitable method.

Capitalists are surely wise in waiting to see which process is likely to be the most advantageous before spending money on plants, which for all we know to-day, in a few years may have only a scrap-iron value.

It is greatly to be feared that any remedy based upon the treatment of coal after it is won would not help the situation. As Mr. Lawton truly enough points out, any improvements in the utilisation of coal cannot possibly be confined to Britain, but will be universally adopted by other nations engaged in coal production, so that we necessarily come back to the economic proposition that the future of coal rests with those nations that can produce it cheaply. There is, in fact, only one remedy for the present critical position of the British coal industry, and that is the cheaper production of coal, which, as already said, means a greater output per man employed in the industry. A colliery that is unable to produce coal at a price less than the coal is worth in the world's markets is not a national asset but a national liability so long as it continues to work, and no method of treating the coal after it has been raised can possibly alter that cardinal fact.

HENRY LOUIS.

Science on Exhibition

Phases of Modern Science Published in connexion with the Science Exhibit arranged by a Committee of the Royal Society in the Pavilion of His Majesty's Government at the British Empire Exhibition, 1925 Pp vii+232 (London A and F Denny, Ltd, 1925) 3*s* 6*d*

THAT a space should have been set aside for scientific exhibits at the British Empire Exhibition is a compliment, well deserved but not the less welcome, to the progress of modern science That the task of filling this space should fall upon the Royal Society was inevitable, and it would certainly be difficult to conceive, and impossible to convene, a stronger committee than that appointed by the Society for the purpose The volume which we have before us, with the title " Phases of Modern Science," contains a record of its second and revised version of a scientific exhibition The actual guide to the exhibits occupies the second and smaller portion of the book The first and larger part consists of articles, by many of our most eminent men of science, dealing, more or less directly, with the subjects which the exhibits are intended to illustrate Chemistry is not dealt with, the exhibits in this branch of science having been arranged by the Association of British Chemical Manufacturers in the Palace of Industry

There is a notion current that scientific workers are shockingly bad showmen They are accused of being in possession of all kinds of fascinating secrets which they are either unwilling or more probably incompetent to communicate They are supposed, through some defect in their education, to be unable to speak in language understanded by the people, and from time to time journalists have attempted to translate this scientific jargon into their own, with results which have not always been happy We think that a careful study of the articles in this volume should convince any unprejudiced reader that the accusation is without any real basis It is difficult to imagine how the present state of our knowledge of radiation, for example, could be expressed more simply and, we may add, more delightfully than in Sir Oliver Lodge's introductory article on " Radiation," or how recent advances in astronomy, made as they were by a masterly combination of physical imagination and mathematical analysis, could be conveyed more happily than in Prof Eddington's article on " The Interior of a Star " If it is not invidious to pick out one article when so many are good, this contribution of Prof Eddington, which is abstracted from a Royal Institution discourse, strikes us as a model of popular scientific exposition Sir Ernest Rutherford on " Electricity and Matter," and Dr Aston on " Atoms and Isotopes," are almost equally successful

It is not, of course, to be assumed that these articles can be followed entirely without effort by a reader devoid of scientific knowledge The temple of science is, unfortunately, not furnished with lifts, and whosoever would ascend to the upper stories, where building is in progress, must be prepared to do a little climbing, however skilful his guide may be The phases of modern science dealt with in this volume are the culmination of many years of scientific discovery and research, and some knowledge of this preliminary work is necessary, not merely for understanding but even for enjoyment The delight of the spectators when a conjurer produces a rabbit from a top-hat is founded on their previous knowledge of the natural history of top-hats and rabbits, and the thrill which the scientific world experienced when Sir Ernest Rutherford produced hydrogen from nitrogen is similarly based on some previous knowledge of the chemistry of these substances, and is not to be achieved by one to whom both hydrogen and nitrogen are equally unknown It is to such inherent difficulties, and not to any lack of showmanship, that we must ascribe the hiatus which we all deplore between the scientific worker and the public

All parts of science do not present equal difficulties, and, it must be confessed, all eminent men of science do not possess the same facility for popular exposition In the " Circulation of the Atmosphere," and in the " Water in the Atmosphere," Sir Napier Shaw and Dr G C Simpson have subjects which appeal to the man in the street, ever interested in that perennial source of conversation, the weather, and deal with them in a way which will appeal not only to the general reader but also to the scientific worker who has not hitherto chanced to stray down the interesting by-path of meteorology Prof Fowler, on the other hand, in the " Origin of Spectra," and Dr Chree in " Atmospheric Electricity," are clearly writing for students of science, and make no attempt to reach the uninitiated Both articles are good of their kind, and Dr Chree's, in particular, is a valuable summary of facts and phenomena which the physicist does not usually stumble across in his ordinary reading

Of the biological articles, which occupy a somewhat unduly small space in the volume, the majority deal more or less directly with the theory of evolution and natural selection The conclusions drawn are not such as would commend themselves to the stalwart " Fundamentalists " of Tennessee In this portion of the book the present reviewer can claim to be in the position of the general reader, and can testify from personal experience that, though he can understand the complaints

which are lodged sometimes of too free a use of technical language by scientific writers, these biologists have certainly succeeded in "getting their ideas across" His only regret is that they do not fill a larger space in the bill There are, however, strict limits to the amount of printed matter which can be sold at the modest price of this volume

Of the exhibits themselves it may be said, in conclusion, that they prove that to his own peculiar audience, the man of science can be an incomparably fine showman The fact that the exhibits are confined almost wholly to the more recent developments of science makes it inevitable that their principal appeal should be to the serious student of science To the younger students, and particularly to those from the smaller seats of learning, somewhat remote from the larger institutions where the tide of research flows at its fullest, this collection has been a source of inspiration and delight By them, at any rate, this little volume will be cherished as a memento of a memorable event, while many others may find in its introductory articles a pleasant and convenient means of learning, on the best authority, the present position of knowledge and conjecture in phases of modern science which are not peculiarly their own

The Realm of Plants

Plants and Man a Series of Essays relating to the Botany of Ordinary Life By Prof F O Bower Pp xii+365 (London Macmillan and Co, Ltd, 1925) 14*s* net

IF an extra-terrestrial observer, gifted with superhuman powers of ocular accommodation and unhampered by human prejudices as to man's position in the scheme of things, were given the opportunity of surveying with detachment the myriad-patterned pellicle of life that invests the earth, the function of the human species might afford him material for confusing speculation As he gazed on some parts of the planet he might be driven to entertain an Erewhonian conception of man's relation to machinery, but, surveying the greater part of the land surface, he might well be excused for concluding that man's chief function was the distribution of certain dominant species of plants, for he would see almost everywhere men toiling to spread the triumphant grasses and a host of other less dominant but still powerful green organisms In this view of man's relation to plants, our extra-planetary philosopher would not be without a certain amount of human concurrence, for to a large section of humanity a seductive species of Rosaceæ represents the primal cause of man's introduction to that distasteful (?) form of activity known as work

Although in his latest book Prof Bower has not expounded the polity of plants from quite such a Saturnian point of view, both the order of its title, "Plants and Man," and the presentation of its matter, are not without a tincture of such significance His theme is the mutual reactions of plants and man, skilfully leading on to the final vision of the fundamental dependence of man on his fellow-creatures the plants for all that he has become and yet may be It is impossible within the compass of a review to give an adequate idea of the multifarious relations between plants and man so succinctly and clearly presented in the thirty essays that form the book, and an attempt at a general indication of its contents must suffice The first five essays are devoted to the green cell that tints the continents and islands, and is the foundation of all life thereon and in the sea, and to the general scheme of construction and the vital processes of the complicated commonwealth of cells that forms plants The influence of the seasons is touched upon in another essay, and after this general introduction the reader is taken in pleasant and suggestive discourse by meadow and pasture, through woodland, over moor and mountain, and along the shore

From these varied and extensive excursions we come to the only relation that plants have to "play" The struggle for existence and supremacy amongst themselves, although it might permit rest, would allow of no indulgence in "play," even if it were not inhibited by the line of life they have chosen, but in the share they take in the formation of golf links and playing fields, plants make some amends to man for his expulsion from an idle Eden After play comes consideration of man's most intimate active relation with plants, that fundamental form of work, cultivation, which under flowers and fruits, vegetables and grains, is discussed with a wealth of allusion and illustration Human interest in a derivative form of work, engineering, gives the keynote to three essays on the mechanical construction of plants, and on the methods by which they have solved the mechanical problems forced upon them by the conditions of their life, and have anticipated many of man's engineering devices The physical properties of wood and bast, which permit of an amazing range of application from house-building and cloth-weaving to the divine music of the violin, are the subject of two chapters In their final function in completing the full circle of the wheel of life, which starting from the inorganic, through the green cell returns to the inorganic through fungi and bacteria, plants are shown as the earth's prime sanitary agents and indispensable to man in his most advanced sanitary practice

The close social life of plants and the various

expedients—ranging from mutually beneficial co-operation to the worst forms of parasitism—by which plants attempt to cope with the ever-pressing problems of over-population and unrestricted competition are admirably outlined in several chapters. These same problems bid fair to be the supreme ones of the future for humanity also, and in the human handling of them the world of plants is not only a living lesson and a warning, but will dictate some of the most important conditions for their solution. It is, therefore, well that the note of the concluding essays should be man's dependence and influence on vegetation. Prof. Bower rightly emphasises the tragic aspects of man's interference with the balance of plant life—and, as a consequence thereof, with animal life also. In this, as in other things, the evil wrought by one generation lives after it to plague those that follow. Happily one need not yet conjure up the dreadful vision of a day when man will have brought it about that over all the earth the desert will be the only contrast to the sown, but much depends on man using his powers with more discrimination in the future than he has in the past. It is in helping to spread appreciation of this, no less than in its enjoyable presentation of the life and work of plants themselves, that Prof. Bower's book has a value all its own.

Ether and Erdgeist

Ether and Reality: a Series of Discourses on the many Functions of the Ether of Space. By Sir Oliver Lodge. (The Broadcast Library.) Pp. 179. (London: Hodder and Stoughton, Ltd., 1925.) 3*s.* 6*d.* net.

EVERYTHING that Sir Oliver Lodge writes bears so clear an imprint of his powerful and persuasive personality that a book bearing his name may be confidently anticipated to hold the reader's interest and stir his imagination. In the present little work such an expectation is not disappointed. Sir Oliver has a well-known enthusiasm for a massive, elastic, all-functioning ether of transcendent reality, and his whole-hearted belief finds expression in a lively, yet learned, eloquence which does justice to his theme. He treats of the ether in the most comprehensive spirit, and his book contains not only a survey of all the wider problems of physics in connexion with which an ether may be invoked, but also philosophy, elevating moral reflections, and an inspiring vision of the perfectibility of man.

The point of view is, perhaps, best expressed by a sentence taken from the chapter on "The Ultimate Physical Reality": "Speculatively and intuitively we feel to be more in direct touch with the ether than with matter." Sir Oliver regards the ether less as a working hypothesis than as a revealed reality. He sees in it a possible vehicle for psychical manifestations of man's individuality—consciousness, memory, and affection. "It is the primary instrument of Mind, the vehicle of Soul, the habitation of Spirit. Truly it may be called the living garment of God." It is in almost these words that the Erdgeist in Goethe's *Faust* speaks of his activities:

> So schaff ich am sausenden Webstuhl der Zeit
> Und wirke der Gottheit lebendiges Kleid.

It is not on physical evidence alone that Sir Oliver relies, but on something of the mystic inspiration and psychic experiences which prompted the great poet's words.

In spite of the charm and simplicity with which the book is written, some difficulty may be experienced in understanding exactly what Sir Oliver wishes to lay down as regards the physical properties of the ether. For example, he says that the fact that the ether transmits waves proves that it must possess elasticity and inertia, because material bodies that transmit waves have these properties, and then says: "The possession of these properties makes the ether very real." But as the possession of a quasi-material mechanism must be postulated in order to endow the ether with these properties, this does not, to the present writer, appear convincing. Again, he says at one place that "Ether is not to be explained in terms of matter," but this, apparently, does not mean that the ether is not to be given many properties of matter. At the heading of one chapter he quotes a passage from Einstein containing the words: "But this ether may not be thought of as endowed with the quality characteristic of ponderable media," yet he nowhere discusses the difficulty presented by the fact that the ether cannot be used as a frame of reference. The present writer has no desire to carp: he gratefully acknowledges the pleasure he has got from reading the book, yet he cannot see what is gained by calculating a mass and an elasticity for an ether which has not the properties of a ponderable medium, so long as these properties of mass and elasticity serve only to explain the very transmission of waves which is the ground for their postulation. Of course, if they helped to understand cohesion or gravitation, of which Sir Oliver explains the ether to be the seat, or the behaviour of light in the neighbourhood of gravitating matter, every one would welcome them, but, as it is, to some they may well seem *entia praeter necessitatem multiplicata*. There is, by the way, nothing said of the possibilities of Silberstein's ether of variable density, condensed at the surface of material bodies, which recent experiments suggest will have to be seriously considered.

The book is, of course, intended for non-technical

readers, and is bound to have a wide circulation and give delight to very many The points that have troubled the present reviewer are very possibly not such as will trouble those approaching the book with a wider outlook The general spirit of the little book is admirable, and, after all, that is what counts

E N DA C A

The Study of Physical Chemistry

(1) *Physical Chemistry for Students of Medicine* By Prof Alexander Findlay Pp ix+227 (London Longmans, Green and Co , 1924) 8*s* 6*d* net

(2) *L'Énergetique des reactions chimiques leçons professées à la Sorbonne* Par Prof G Urbain (Collection de Physique et Chimie) Pp viii+267 (Paris Gaston Doin, 1925) 25 francs

(3) *Les notions fondamentales d'element chimique et d'atome* Par Georges Urbain (Science et civilisation Collection d exposés synthetiques du savoir humain) Pp iv+172 (Paris Gauthier-Villars et Cie, 1925) 10 francs

(4) *Inorganic Physical Chemistry* By Prof G H Cartledge Pp xvi+463 (Boston and London Ginn and Co , Ltd , 1924) 22*s* 6*d*

(1) PROF FINDLAY'S "Physical Chemistry for Students of Medicine" recalls in its appearance as well as in its literary qualities the books by this author which are already familiar to all students of chemistry It is, however, only necessary to read as far as the title of the second chapter, "The Aqueous Milieu of the Life Processes," in order to realise that the biological aspects of physical chemistry have been thrust into the forefront, in order to secure the interest and attention of the medical student, since it is not usual for a physical chemist to describe his favourite aqueous solutions and suspensions under so foreign a designation The writer of such a book as this can achieve his object most readily by teaching the familiar and fundamental truths of his science with the help of novel illustrations derived from that field of applied science in which his readers are interested We therefore find the problems of solubility, surface tension, viscosity and osmotic pressure illustrated by reference to the behaviour of blood and urine, and to the plasmolysis of cells or the hæmolysis of blood-corpuscles This method, when used by a teacher of experience, not only interests the reader, but also has the further advantage of showing him how to apply the methods of pure science to his own specialised studies No proof is needed to establish Prof Findlay's skill as a writer on physical chemistry the present volume appears to the reviewer to prove that he has at least familiarised himself sufficiently with the biochemical aspects of his subject to enable him to provide a useful guide for biological workers who wish to join him in this field of work

The author will perhaps pardon, as a personal weakness of the reviewer, the prejudice which makes him regard it as a retrograde step, after teaching the student to write the formula of an amino-acid as an internal salt, $\overset{+}{N}H_3 \; CH_2 \; CO \; \overset{-}{O}$, to finish by asking him to regard this ion as having neutralised its two charges by swallowing its own tail, after the manner of a fried whiting It is not every fish that can be induced to perform this acrobatic feat, and Pfeiffer's proof that "distance is no object" in preparing a betaine from an amino-acid, since these can be produced from *meta* and *para* as readily as from *ortho* aminobenzoic acid, seems to provide conclusive evidence that the amino-acids are under no obligation to strain their backbones in the manner suggested

(2) Prof Urbain's book on "The Energetics of Chemical Reactions" is the third volume of a new "Collection de Physique et Chimie," of which two preceding volumes, on "Colour and Chemical Constitution" and on "Thermochemistry," have already been reviewed in these columns (May 24, 1924, p 739, and August 16, 1924, p 240) Prof Urbain claims that physical chemistry is not merely the overlapping section of physics and chemistry, but that it is a pioneer science which opens up new fields, which are afterwards added to the domain of these two sciences He gives to his illustrious colleague, Le Chatelier, the credit for having been the first in France to introduce thermodynamics into chemistry, and asserts that "at the present time no one can call himself a chemist if he ignores tne principles of thermodynamics and the method of applying them correctly to chemical phenomena in general, and more particularly to chemical equilibria" Such a test, if applied rigidly, would certainly exclude from the author's chemical "kingdom of heaven" some of our very "rich men," whose wealth of knowledge and experience could not be squeezed through the "needle's eye" of chemical thermodynamics Whilst, however, we may repudiate the idea of excommunicating all those of our colleagues who are repelled instead of being attracted by the mathematical treatment of chemical problems, there is much to be said for the author's policy of writing a book on thermodynamics from the point of view of the chemist, rather than of the physicist or mathematician, and so minimising the difficulties of assimilating this method of treatment

The book is in three parts, an introduction, which covers the general principles of thermodynamics, a very short section on thermochemistry (which has already formed the subject of a separate volume of this series),

and a third section, filling more than half the volume, on the "Modern Theory of Affinity." The treatment ignores all "atomic" explanations, not because they are regarded as of no value, but simply because they are superfluous to the object immediately in view. A further volume of the same collection is promised, in which the applications of the principles now taught will be discussed for their own sake, instead of being used merely as illustrations of general principles.

(3) Prof. Urbain's book on elements and atoms is issued under the general heading of "Science and Civilisation" instead of "Physics and Chemistry." It deals with the definition of an element, radioactive elements, the constituents and structure of the atom, the relation between the properties of elements and the constitution of their atoms and finally with isotopes. The International Table of Radioactive Elements is given on a folded sheet at the end of the volume. The author's style is attractive and interesting, and although he is addressing himself to an audience of general readers, his views on the question of how an element should be defined have a special interest at the present time for chemists. This question is discussed in a chapter of 50 pages, which occupies nearly one-third of the book; and the final conclusion, that the International Commission of the Chemical Elements was right, when in 1923 it reported that "an atomic number is necessary and sufficient to define a chemical element," is qualified by a final paragraph which contains a single brief sentence, asking whether "in the physical sciences, all definitions must not be only provisional?"

(4) Prof. Cartledge's book appears to have been written in order to meet the need in the curriculum of the Johns Hopkins University, of providing instruction in physical chemistry for undergraduate students, at such an early stage in their course that they cannot be assumed to be familiar with organic chemistry. This has led to the production of a book in which particular emphasis is placed upon the properties of aqueous solutions, including especially such subjects as hydrolysis, acidity and the formation of complex ions. Fortunately the author has not gone to the extreme limit of excluding *all* organic compounds from his consideration, since he has found it necessary to illustrate the vapour-pressures of aqueous solutions from the case of mannitol, their osmotic pressure by data for sugar-solutions, whilst the cryoscopic and ebullioscopic methods of determining molecular weights are illustrated by the use of benzene and other organic compounds as solvents. A still more notable example is that of "The Speed of Reactions," where the principal actions studied are derived from the field of organic chemistry.

Apart from sheer necessity, this subdivision of the field of physical chemistry appears to the reviewer to be wholly undesirable. Physical chemistry has now emerged from the grotesque stage in which it appeared to concern itself exclusively with the study of *dilute aqueous solutions*, and when Faraday was not classed as a physical chemist because his work was published before the foundation of the *Zeitschrift fur physikalische Chemie*; the limitations imposed in the volume now under review have the effect of replacing the old fetters, and of making the least typical of liquids appear as the only typical solvent. Such limitations are entirely retrograde, and it is to be hoped that other universities will escape from the necessity of imposing them upon their teachers of physical chemistry.

T. M. LOWRY.

Climates of the Past

Die Klimate der geologischen Vorzeit. Von Wladimir Koppen und Alfred Wegener. Pp. iv+256. (Berlin: Gebruder Borntraeger, 1924.) 11*s*. 6*d*.

THIS monograph on the climates of the past is essentially a supplement to Prof. Wegener's work on continental drift. It endeavours to show that the former variations of climate can be best explained by Wegener's theory that all the land on the earth was originally one continuous continent which has been broken up, that the pieces have drifted apart, and that the north and south poles have migrated to their present positions.

The authors first discuss the nature of the geological evidence of former climates, and they claim, amongst other points, that all the great coal formations have originated either on moraines or on beds that have been recently folded. They then describe the distribution of climate in the Carboniferous and Permian Periods, and one of the most useful contributions in the book is the account of the glaciation of parts of the ancient continent of Gondwanaland; the section on the South American evidence is especially valuable. They next discuss the climatic zones in the Mesozoic and the Kainozoic, and follow with a chapter on the records of pre-Carboniferous glaciation which accepts without hesitation some cases that are regarded by some authorities as highly doubtful, and omits reference to other records. The final chapter discusses the Quaternary glaciation, which it attributes to variations in solar radiation.

The book gives tables of the solar changes in radiation for the past 800,000 years, and endeavours to fix the date of the successive glaciations. The discussion of the causes of the Pleistocene glaciation by two distinguished meteorologists shows that the theory of

its dependence on changes in solar radiation must be seriously considered

The geological section of the book is a compilation of the facts which appear to support the authors' thesis, but it is often unconvincing from unfortunate selection of geological evidence They accept, for example, the existence in the Silurian rocks of Bohemia and the Hartz Mountains, of Lepidodendron, Stigmaria, and Sphenopteridium — a conclusion which, if accepted, would render futile all recent palæo-botanical discussions on the beginning of the land flora The authors' claim that the variations of former climates can be explained by a shift in the positions of the pole combined with a drift of the continents is not convincing even on their own evidence Their work is most detailed in reference to the climate in the Carboniferous Period, yet the Squantum tillite occurs exactly on their Carboniferous equator, they reject that formation as pseudo-glacial, but it requires stronger evidence than the authors bring forward to explain it by any non-glacial theory The distribution of the Jurassic climate also appears more consistent with Neumayr's view of zones concentric around the present poles than with the position the authors assign to the Jurassic poles, as they carry the boreal province within 20° of their equator

The book has no index, which is an especially unfortunate defect, as its chief value rests on its extensive collection of information as to former glaciations and biological distribution from the scattered literature on those subjects The book will be more useful from its summary of little-known facts than convincing of the authors' theory

Our Bookshelf

Contributions to Embryology Vol 16, Nos 78-84 (Publication No 361) Pp 276+32 plates (Washington Carnegie Institution, 1925) n p

THANKS to the munificence of the late Mr Andrew Carnegie, American embryologists are enabled to place the results of their inquiries before the world in a superb form The sixteenth volume of "Contributions to Embryology" maintains the high standard set by its predecessors, text and illustrations are excellent and the "contributions" are deserving of them

The present volume, which includes seven papers, illustrates the new departures which are being made from recognised orthodox methods by modern embryologists Only three of the seven papers follow conventional lines Dr F Payne gives clear and exact drawings of reconstructions made of a human embryo in the fourth week of development, Dr Cecil M West makes a welcome contribution to later stages in the development of the gums and tooth-buds of human fœtuses, while Dr G B Wislocki describes certain new features in the placentation of the sloth (*Bradypus griseus*) Prof Alex Maximow approaches the problems of embryology from the experimental side He describes the behaviour of parts taken from embryos of rabbits and kept alive for various periods by methods adopted for the culture of living tissues The results throw light on that kind of tumour which occurs occasionally in human beings and is known as an embryoma

In a series of three papers, Prof Florence Sabin, in collaboration with Dr C A Doan and R S Cunningham, attacks the old problem of the origin of blood corpuscles by a new route—a physiological route They have studied the production of new blood corpuscles in animals which had been rendered anæmic, using vital stains for the detection of the various kinds of corpuscles which are then produced The result is the construction of a new schema of the ancestry of all kinds of cells which appear in blood or free cells which may be encountered in the tissues outside blood-vessels Of great clinical importance is their discrimination of two forms of phagocytes—the clasmatocyte, which arises from the endothelial cells lining capillaries, and the large monocyte which is produced from cells occurring in reticular connective tissues of all sorts, the latter, unlike the clasmatocyte, arises outside a capillary lumen It will thus be seen that modern embryology becomes more and more a branch of experimental research

General and Physiological Features of the Vegetation of the more Arid Portions of Southern Africa, with Notes on the Climatic Environment (Publication No 354) By W A Cannon Pp viii + 159 + 31 plates (Washington Carnegie Institution, 1924) n p

THE author of this volume spent six months' leave in South Africa in the latter half of 1921 During that time he introduced Livingston atmometers to South African botanists, distributed through the Director of the Union Botanical Survey a number of standardised atmometers at various stations through the Union, and arranged for the recording of weekly evaporation, he visited the principal arid and semi-arid regions, sampled the characteristic plants and the transpiring power of their leaves, examined the leaf anatomy and root systems of Karroo plants, and took a number of excellent photographs In the volume under notice the photographs are beautifully reproduced and the data he collected are brought together

South African botanists will find much to interest and stimulate them, and will welcome the impressions of an observer with so varied an experience of arid regions, who can compare from first-hand knowledge the vegetation of the drier parts of their country with that of other parts of the world under comparable climatic conditions His example will strengthen the movement already evident, from purely floristic towards ecological investigation of the South African flora He has directed attention to those features of the plants which are of special importance in connexion with their water relations, and he has demonstrated that with a few simple appliances physiological data of value can be obtained out on the veld Observations were even made on the transpiration of *Welwitschia mirabilis* in the Namib desert, they suggest that the leaves of this curious plant transpire far more freely

than might have been anticipated from their xerophytic structure and the extreme aridity of the environment

The atmometric data are somewhat disappointing It is clear that they require a scrutiny to which the author had not been able to subject them at the time of publication, and are not uniformly trustworthy A "Fig 8," representing some of the data graphically, is referred to on pp 44 and 55, but is not to be found in the book There are also a regrettable number of printers' errors which have escaped correction For example, 'casual" appears in two successive lines on p 3 in one or other of which it should surely read "causal", while two variants on "Matjesfontein" appear on pp 68 and 71 The "typography" of a district is referred to on p 69, "Protaceae" for "Proteaceae" on p 110, and so on

Mechanical Refrigeration being a Practical Introduction to the Study of Cold Storage, Ice-making, and other Purposes to which Refrigeration is being Applied By Hal Williams New and enlarged edition (The Specialists' Series) Pp x+501+6 plates (London Sir Isaac Pitman and Sons, Ltd, 1924) 20*s* net

THE volume under review is a new edition of Mr Hal Williams's well-known book on mechanical refrigeration, which has now been amplified and largely rewritten It contains a useful summary of the present state of our knowledge of refrigeration in its broadest aspect, and, as it does not go unduly into minute detail of design and equipment, it will appeal to all interested in the vital problem of the conservation of the food supply of the nation

The book is descriptive rather than theoretical in its treatment of the subject, and a valuable feature is the account given of recent applications of refrigeration to such industries as paraffin crystallisation, mine shaft freezing, and so on Another noteworthy feature in the new edition is the attention given to the high-speed total enclosed compressor This type of compressor is an important step in the development of refrigerating machinery which has been taking place in recent years

The general lay-out of the book partakes more of the nature of a dictionary than a text-book, for each paragraph is sub-headed under such titles as "Unit of Pressure," "Liquid Coolers," "Buying Machinery" This facilitates the use of the volume as a work of reference The illustrations are plentiful and include a number of folding plates, but it is questionable whether these justify their cost in a book of this character The author has given a prominent place to one very important application of refrigeration, namely, the overseas transport of fruit, for this industry is destined to be a vital factor in the development of the British colonies E G

A Catalogue of the recent Sea-Urchins (Echinoidea) in the Collection of the British Museum (Natural History) By Hubert Lyman Clark Pp xxviii+250+12 plates (London British Museum (Natural History), 1925) n p

DR H LYMAN CLARK, of the Museum of Comparative Zoology, Cambridge, Mass, who is one of the outstanding authorities on echinoderms, has given in this catalogue the results of his studies, extending over some months in 1924, of the British Museum collection This has been known as one of the important collections of sea-urchins since the time of J E Gray's first connexion with the Museum in 1824, in which year he published a paper—dealing with about 50 species—which may be regarded as the foundation for a catalogue For thirty years Gray continued his study and, at intervals, his publications on sea urchins Since his time the collection has received notable additions from the expeditions of the *Challenger*, *Alert*, *Penguin*, and *Egeria*, from the collections made by Prof A Willey and Prof J Stanley Gardiner, and from those made during the recent British Antarctic Expeditions, it now ranks as one of the foremost collections of the world It contains about 8000 specimens representing 382 species grouped in 146 genera, and Dr Clark directs attention to the wealth of large examples in many of the series He gives a table showing that in the collection is type material of 111 forms, 25 of which are new species or varieties described in this volume

Dr Clark has made available to students of the Echinoidea an accurate account of this great collection, and his catalogue serves also as a handbook for the identification of most sea-urchins Twelve excellent collotype plates provide illustrations of the new species

Recent Advances in Medicine Clinical, Laboratory, Therapeutic By Dr G E Beaumont and E C Dodds Pp xii+292 (London J and A Churchill, 1924) 10*s* 6*d* net

THE rapidity with which the study of medicine advances makes it necessary for the physician and clinical pathologist to keep constantly in touch with new methods of investigating and treating disease With limited time and material for research, it is impossible for the busy practitioner to test these for himself, or to isolate from the vast accumulation of recent medical literature what is likely to be of practical value In "Recent Advances in Medicine" a physician and a biochemist collaborate to give an account of the more important changes in clinical and laboratory routine methods of the last decade, and to indicate the relative value of the results obtained The book covers a very wide field, including such subjects as blood analysis, renal, hepatic, and pancreatic functions, test meals, the polygraph and electrocardiograph, artificial pneumothorax, and various cutaneous and serological tests Some of these might with advantage have received less attention, for example, the electrocardiograph and its tracings are of little value except to the specialist X-ray investigation of the stomach, to which less than a page is devoted, is of far more interest to practitioner and student

The book will be welcomed as a very useful addition to the practitioner's library It contains numerous references and is excellently indexed

Conformal Representation By Leo Lewent Translated by Dr R Jones and D H Williams Pp viii+146 (London Methuen and Co, Ltd, 1925) 7*s* 6*d* net

THE work under notice is a translation of Dr Leo Lewent's "Conforme Abbildung" (Teubner) It opens with an account of functions of a complex variable from the Cauchy-Riemann point of view A long

chapter is devoted to special transformations, with detailed discussion of linear transformations and stereographic projections, but without reference to group theory. The account of algebraic transformations necessarily introduces Riemann surfaces, the two-sheeted ones being mainly considered. Riemann's conjecture, that any simply connected surface can be represented uniquely, continuously, and conformally on the area of a circle, has been made the foundation of many brilliant investigations by such mathematicians as Heine, Schwarz, Weierstrass, Osgood, Poincare, and Koebe. A general account of the whole question is given in the book before us, without entering into the necessarily elaborate pure mathematics involved in much of the work on the subject. The last chapter, dealing with conformal representation by means of elliptic functions, was written by Dr. Blaschke, Dr. Lewent having died before his plan was completed. In the present translation, Dr. Jones and Mr. Williams have provided a very readable introduction to the theory of conformal representation. Some matters are discussed in the German text in a descriptive (rather than a scientific) way, but the translation is none the less acceptable on that account. W. E. H. B.

Kolloidchemie der Protoplasmas. Von Prof. Dr. E. Lepeschkin. (Monographien aus dem Gesamtgebiet der Physiologie der Pflanzen und der Tiere, Band 7.) Pp. xi + 228. (Berlin: Julius Springer, 1924.) 9 gold marks.

THE author has catered for the student in a very thorough manner, and devotes the first quarter of the book to a complete survey of the various physico-chemical phenomena associated with colloids, particularly proteins. The colloid chemistry of protoplasm is then developed and discussed from different points of view until finally the author presents a detailed and up-to-date account of the behaviour of protoplasm under the action of physical agents, such as temperature, light, and electricity, and that produced chemically by acids, alkalis, neutral salts, and non-electrolytes. One feels, however, that more might have been made of the effects of low temperatures and particularly of freezing temperatures, including, as it does, not only the temperature factor but also those due to desiccation and probably change in acidity. The book will appeal in particular to the plant physiologist.

There is one very fine plate containing twenty-two microphotographs of several living systems under different conditions, but surely a book of this nature is lacking in having no diagrams whatsoever. It is, nevertheless, well written, covers a wide field, and treats a difficult subject in a most interesting and clear manner.

A Monograph of the Birds of Prey (Order Accipitres). By H. Kirke Swann. Part I. Pp. xi + 52 + 5 plates. (London: Wheldon and Wesley, Ltd., 1924.) 26s. net.

IN this monograph, which is being issued in twelve parts, Mr. Swann is bringing up-to-date the results of his recent intensive study of the diurnal birds of prey. In his introduction, which includes a chapter on falconry and hawking, it is stated that he now recognises 322 species and 692 subspecies or forms, while the genera employed number 100. In 1874 Sharpe (Catalogue of the Birds in the British Museum, vol. 1) gave the number of species as 377, but many of these are now considered subspecies. It will therefore be seen that in the last fifty years the number of apparently distinguishable forms has nearly doubled.

Part I. deals with the New World vultures and some of those of the Old World. Each form is separately discussed; its synonymy is given, then its distribution and different plumages in detail, followed by general remarks and notes on food and nesting. We are glad to observe that the status of each species is clearly shown; the typical race is first described; any subspecies bears the same number with the addition of a letter. This arrangement, we think, might with advantage be adopted by modern authors. The changes in nomenclature are many, and are in strict accordance with the rules of priority.

The letterpress and paper are excellent, and the coloured plates, which are by Mr. Gronvold, leave nothing to be desired. We heartily congratulate the author on the production of this work. The edition is limited to 412 copies.

Chemistry in the Service of Man. By Prof. Alexander Findlay. Third edition, revised and enlarged. Pp. xix + 300 + 4 plates. (London: Longmans, Green and Co., 1925.) 6s. net.

PROF. FINDLAY'S book, which has now reached a third edition since its first appearance in 1916, is one of the best accounts of modern chemistry for the lay reader. Unlike many books of this kind, it is written in a dignified style and without insistence on commercialism. The subjects dealt with cover various fields, and the book cannot fail to continue to be popular. It is very suitable for general reading by pupils in higher forms of schools as well as for those older readers who have not specialised in chemistry, since it supplements the ordinary text-books. Three new chapters on radioactivity and atomic structure, on the rare gases of the atmosphere, and on metals and their alloys, have been added in the new edition, and the whole has been revised and brought up-to-date.

The Rare Earths: their Occurrence, Chemistry, and Technology. By Dr. S. I. Levy. Second edition. Pp. xvi + 362. (London: E. Arnold and Co., 1924.) 18s. net.

THE volume under notice is especially characterised by its eminently readable style. The subject is dealt with exhaustively, yet the material is presented in such a way that an honours student could read the whole with profit, whilst the expert will find full references to recent work apart from the detailed treatment in the text. Methods of separation and tests are dealt with as well as the chemical properties of the elements, and the names, occurrence, and composition of the minerals. The book will be welcomed by chemists, and is well printed, and provided with an adequate index. Theoretical considerations of classification and atomic structure are considered, but a just sense of proportion has been preserved. The book contains all the information that the chemist who is not a specialist in this department will require.

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE *No notice is taken of anonymous communications*]

The Shapes of Birds' Eggs

ANY notable geometrical symmetry in natural productions invites examination, and among such cases of symmetry the forms of hard-shelled eggs may be included I remember, on chucking certain eggs in a lathe, being surprised to find that they ran nearly as true as if they had been turned, and there are several points of interest both in respect of the close conformity of their shapes to solids of revolution and also in regard to the character of their generating curves

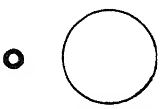

FIG 1 —Capsule with walls of uniform thickness before and after inflation

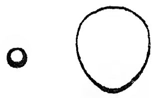

FIG 2 —Capsule with walls of varying thickness before and after inflation

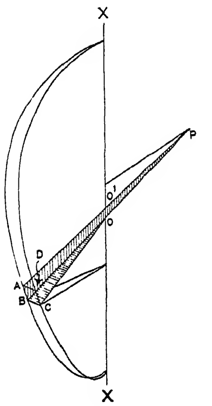

FIG 3 —To indicate the relation between the principal stresses and principal radii of curvature in a closed vessel

Symmetry of this kind must have the same sort of origin as that of an inflated balloon, or of the aneurism which forms in an india-rubber tube when the internal pressure exceeds a certain limit

No doubt the oviduct in which the shell is developed supplies the necessary pressure, whether acting merely as an elastic coat stretched by the growth of the contents, or by actual muscular stress in the non-striated fibres in its walls, the near approach, however, of the transverse sections to true circles implies that the pressure (measured in terms of head) is large compared with any difference of pressure between the upper and lower parts of the egg cavity, for although the pressure of the various parts in external contact with the oviduct must tend to balance the gravitational head in the interior, it is not likely that this balance is at all exact, and, as may easily be shown, small differences of pressure round the periphery of a transverse section would, in the absence of contractive force in the walls, produce comparatively large departures from the circular form

From the measures given below I should estimate that the pressure within the oviduct is of the order of a hundred times that given by a column of water of the linear dimensions of the shell The forms of the generating curve of the solid of revolution must depend either on a variation of thickness in the elastic walls of the oviduct or a variation of muscular stress in its fibres

This may be illustrated experimentally by the inflation of india-rubber capsules, as shown in Figs 1 and 2 When the walls are of uniform thickness, inflation produces a sphere if the cavity is eccentric, on inflation it assumes the egg shape All the known shapes of eggs can in this way be reproduced by suitably adjusting the thickness of the walls

The relation of the principal stresses and principal radii of curvature in a shell in which there is internal pressure can be deduced from Fig 3

Let the internal pressure be P, and let XX be the axis of revolution of the generating curve of the shell, and ABCD an element of the surface of revolution Also let AP($=\rho_M$) be the meridional radius of curvature and CO($=\rho_L$) that of the curvature in latitude The tension T_M in the shell in the direction of the meridian is equal to P × area BCO—BC × thickness of the shell (t) and in the direction of the latitude it is P × area ABOO′—AB × t From this statement it can easily be shown that

$$T_M = P\ \rho_L/2t \text{ and } T_L = P(2\rho_M\rho_L - \rho_L^2)/\rho_M t\,,$$

also, since the sum of the radial components of the tension must be equal to P,

$$P = T_M/\rho_M + T\ /\rho_L,^1$$

and the ratio of T_L to T_M

$$(2\rho_M - \rho_L)/\rho_M$$

If the solid of revolution is a cylinder, *i e* if $\rho_M = \infty$, this ratio, as is well known, is 2

The forms of birds' eggs range from nearly spherical through ovals to bluntly pointed or peg-top shapes, and in this respect are, so far as my observation goes, much more variable than the hard-shelled reptilian or molluscan eggs, but in all cases there is a big and little end, and in laying, the big end comes out first

A selection of typical forms of birds' eggs is given in Fig 4 The eggs were placed on a photographic plate, vertically under a distant pin-hole, and the definition of the shadow picture is sufficiently good

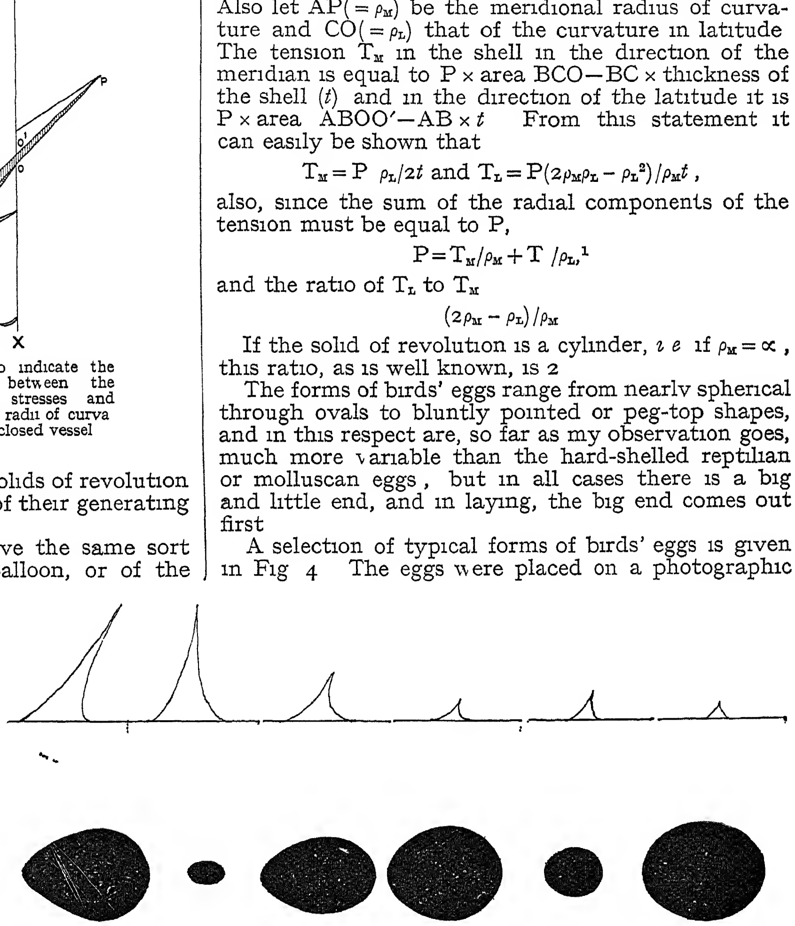

FIG 4 —Typical forms of birds eggs
Figures below are pinhole photographs of the eggs (about one third natural size)
Figures above (drawn to a uniform scale) show the generating curves as dotted lines, and the evolutes in full lines

[1] Since this was written I have been given a reference to a paper by Prof D Arcy W Thompson (NATURE June 4 1908) on the shape of eggs The relations given there between tension and curvature due apparently to Prof W Peddie, are incorrectly stated

to allow of the determination of the curvature with considerable accuracy

Above each figure (and on a scale which makes the long axis of all the eggs equal in length) is the evolute, which is more characteristic than the generating curve itself The evolutes were produced by drawing normals to the generating curve at many points round the periphery, and though individual normals might in some instances be not quite correctly drawn, there could be no doubt about the shape of their envelope (i e the evolute) The ρ_L radii for any given latitude were so nearly constant that their variations could not be satisfactorily determined

I give below, however, a few measures of the greatest and least equatorial diameters of ostrich eggs (too large to be photographed with the apparatus I was using), for in such large eggs, if anywhere, one might expect to find evidence of gravitational deformation

OSTRICH EGGS

No	Locality	Greatest diameter	Least diameter	Difference in parts per 1000	Remarks
1	Masailand	4 872 in	4 865 in	1 4	
2	,	5 042	5 021 ,	4 0	Surface of shell rough
3	Kilimanjaro	4 892 ,,	4 890 ,,	0 42	
4	,,	5 290 ,	5 243 ,,	9 0	Surface of shell rough
5	Wady Abiadh (?)	4 617 ,	4 601 ,,	3 5	
6	,,	4 542 ,,	4 535 ,	2 0	

I have to thank the authorities of the British Museum (Natural History) at South Kensington, for facilities in making these measures

A MALLOCK

9 Baring Crescent, Exeter

Science in South Africa

EVERY man of science will welcome General Smuts' interesting survey, appearing in NATURE of August 15, p 245, of the problems that present themselves for solution in South Africa, for there is no more promising field of research, especially in geophysics

The great astronomical observatories of the southern hemisphere are no doubt already co-operating in a daily comparison of wireless records and celestial observations, which will render it possible to determine in the course of the next few years whether there is at the present time any relative drift of the land masses of the south

Not less important is a provision for systematic gravimetric observations, similar to those that have been carried out in the United States, Central Europe, India, and what was German East Africa If these are sufficiently numerous, they will, in conjunction with the work of the Geological Survey, throw important light on the structure of the earth s crust

At the same time a number of seismological observatories should be established The initial cost of the Milne-Shaw apparatus is comparatively small As the records must be influenced by the geological structure at and near the receiving station, a careful and systematic comparison of the records at different stations of the same earthquakes should be very valuable

Observations on the tidal movements and others of similar periods in the earth's crust, such as were made by Hecker at Potsdam, are also needed in South Africa for comparison with those in other parts of the world They, too, will throw light on crustal structures

For these and other lines of research South Africa affords unequalled opportunities of obtaining important results, and every one must look forward to see her take a place in the commonwealth of science equal to that of the most advanced of older communities

JOHN W EVANS

Transformation of Mercury into Gold

THE experiments on the transformation of mercury into gold (A Miethe and H Stammreich, H Nagaoka) and the suggested explanation of the process (F Soddy) lead me to make the following observations The possibility of the transformation of a nucleus into that of the element next below it by the absorption of one electron is most likely to be detected when both nuclei are stable This occurs most obviously when the elements have a mass in common, an isobare, and, since even mass-numbers are not found in non-radioactive elements of odd atomic number, an isobare of odd mass-number

At the present time there is no direct experimental evidence of the existence of isobares of odd mass-number among non-radioactive elements, but there are two cases where the possibility of their existence may be inferred from experimental work These are the mass-numbers 205 and 199 The existence of the thallium isotope 205 is probable from F W Aston's general results for elements of odd atomic number and from the value, 204 4, for the atomic weight, I have given reasons for the existence of the lead isotope 205 (*Phil Mag*, 1924, [vi], 48, 365) From the atomic weight of gold, 197 2, it may be inferred that this element has isotopes 197 and 199 mercury, as F W Aston has shown, has the isotope 199 There are thus two pairs of elements, lead and thallium, mercury and gold, in which the transformation of the type under discussion may occur I suggest therefore that the transformation of lead into thallium is as possible as that of mercury into gold and that the masses of the thallium and the gold produced are 205 and 199 respectively

There is a possibility that the transformation of lead into thallium by the process under discussion has already occurred in Nature It has been pointed out by me that when any element of odd atomic number possesses two isotopes, the heavier is never in excess Thallium did not appear to be an exception to this rule at the time it was made, as its atomic weight was accepted as 204 0 (the masses of its isotopes are assumed to be 203 and 205), it appeared to be one of the elements of odd atomic number like bromine, silver, and antimony, which have isotopes in approximately equal proportions The new value, 204 4 of thallium's atomic weight, recently obtained, however, makes this element a definite exception It is possible that the excess of the masses of 205 over those of 203 is the result of a process in Nature of an exceptional kind, for example, of the absorption of an electron by the nucleus of the lead mass 205

A S RUSSELL

Christ Church, Oxford,
August 12

Gibbs' Phenomenon in Fourier's Integrals

FOURIER'S integral $\frac{1}{\pi}\int_0^\infty d\alpha\int_{-\infty}^\infty f(\beta)\cos\alpha(\beta-x)d\beta$ is known, under certain general conditions, to have the value $f(x)$ at a point where $f(x)$ is continuous and $\frac{1}{2}\{f(x+0)+f(x-0)\}$ at an ordinary point of discontinuity

It would be natural to expect that the curves

$$y = I_a(x) = \frac{1}{\pi}\int_0^a d\alpha \int_{-\infty}^{\infty} f(\beta)\cos\alpha(\beta - x)\,d\beta,$$

for large values of a would tend, in the neighbourhood of $x=0$, to coincide with the line

$$x=0,\ f(-0) \leqq y \leqq f(+0),$$

when $f(-0) < f(+0)$ the inequalities being reversed when $f(-0) > f(+0)$. However, as we shall now show, this line has to be produced above and below $f(\pm 0)$ by an amount

$$\frac{D}{\pi}\left|\int_\pi^\infty \frac{\sin u}{u}\,du\right|,$$

where $D = |f(+0) - f(-0)|$, *i.e.* by about 9 per cent of the jump D. This corresponds exactly to Gibbs' phenomenon in Fourier's series to which attention was directed by Gibbs in NATURE, vol. 59, p. 606 (1899).

It is sufficient to prove the theorem for a special case: from the known properties of Fourier's integral at a point of continuity of the arbitrary function, it can then be extended to the general case.

We take $f(x) = 1$, when $0 < x < l$, and $f(x) = -1$ when $-l < x < 0$, and equal to zero elsewhere; so that $D = 2$ at $x = 0$.

Then it will be seen that

$$I_a(x) = \frac{1}{\pi}\int_0^a d\alpha\left\{\int_0^l \cos\alpha(\beta - x)\,d\beta - \int_0^l \cos\alpha(\beta + x)\,d\beta\right\}$$

$$= \frac{1}{\pi}\int_0^l \frac{\sin a(\beta - x)}{\beta - x}\,d\beta - \frac{1}{\pi}\int_0^l \frac{\sin a(\beta + x)}{\beta + x}\,d\beta$$

$$= \frac{2}{\pi}\int_0^{ax} \frac{\sin u}{u}\,du - \frac{1}{\pi}\int_{a(l-x)}^{a(l+x)} \frac{\sin u}{u}\,du.$$

It is easy to show that the second integral tends to zero when a tends to infinity; or, stated more carefully, to the arbitrary positive number ϵ there correspond positive numbers A and η, such that

$$\left| I_a(x) - \frac{2}{\pi}\int_0^{ax} \frac{\sin u}{u}\,du \right| < \epsilon \text{ when } \left\{\begin{matrix} a \geqq A \\ 0 \leqq x \leqq \eta \end{matrix}\right.$$

Now the curve

$$y = \frac{2}{\pi}\int_0^x \frac{\sin u}{u}\,du \text{ for } x > 0$$

is situated above the axis of x and cuts the line $y = 1$ an infinite number of times. Its maxima occur when $x = \pi, 3\pi, 5\pi, \ldots$ and continually diminish, tending to $y = 1$ in the end. Its minima occur when $x = 2\pi, 4\pi, 6\pi, \ldots$ and continually increase, tending also in the end to $y = 1$.

Further the curve

$$y = \frac{2}{\pi}\int_0^{ax} \frac{\sin u}{u}\,du$$

is this curve, with the abscissæ reduced in the ratio $1 : a$. Therefore for large values of a the curve

$$y = I_a(x), \text{ when } x > 0,$$

rises from the origin to a point very nearly coincident with

$$x = 0,\ y = \frac{2}{\pi}\int_0^\pi \frac{\sin u}{u}\,du = 1 - \frac{2}{\pi}\int_\pi^\infty \frac{\sin u}{u}\,du = 1 + \frac{0.56}{\pi}.$$

A word or two of a historical nature may be added regarding Gibbs' phenomenon in Fourier's series. As a matter of fact it had been described for the series mentioned by Gibbs in a paper entitled "On a Certain Periodic Function" in the *Camb. and Dublin Math. Journal*, vol. 3 (1848), by Wilbraham (B.A., Trin. Coll. Camb.). To this point my attention was directed some time ago by Prof. G. N. Watson (see also *Enc. d. math. Wissenschaften* II A, 12, p. 1049, and II C, 10, p. 1203). Wilbraham's paper seems not to have attracted any notice, and it had been completely forgotten when Gibbs sent his letter to NATURE in 1899.

Du Bois Reymond dealt with the behaviour of the approximation curves for series and integrals in *Math. Annalen* Bd. 7 (1874) in his paper "Über die sprungweisen Werthänderungen analytischer Funktionen." This memoir would have contained an account of Gibbs' phenomenon in both Fourier's series and integrals if he had not made a curious slip with regard to the possible values of the integral $\int_0^{nx} \frac{\sin u}{u}\,du$, when x tends to zero and n to infinity simultaneously.

Prof. Wilton, of Adelaide, noticed the existence of the phenomenon in Fourier's integrals in a paper "On Gibbs' Phenomenon in Fourier's Series and Integrals" communicated to the *London Math. Society* in 1921. But his argument required further development and this paper has not been published.

The occurrence, or non-occurrence, of the phenomenon in Bessel's and Legendre's series and in divergent Fourier's series which can be summed by other means, has been discussed by various writers. It will be interesting to find if analogous results can be obtained in the case of Fourier's integral and other integrals equal to the arbitrary function.

H. S. CARSLAW.

Sydney, June 16.

The Action of Silica on Electrolytes.

FROM Dr. Joseph's letter in NATURE of March 28, p. 460, it appears that our differences are mainly with regard to observation of facts. I therefore describe below the method of preparation of the hydrated silica used in most of our experiments: it was obtained from the hydrolysis of twice-distilled pure silicon tetrachloride. The silicon tetrachloride in the final distillation was collected in a *transparent fused silica flask*. The liquid was hydrolysed in the same vessel and in the subsequent treatment only fused silica vessels were used. The silica was dried in air at room temperature in a place free from fumes. If Dr. Joseph finds difficulty in preparing the samples, I shall be glad to send him a sufficient quantity for his experiments. I would, however, point out that the silica used by Dr. Joseph differs from ours in one respect in that the silica was heated to 180°. We have found that on ignition, the adsorptive capacity of hydrated silica diminished markedly, and probably the failure of Dr. Joseph to confirm our results is to be attributed to his having used samples which were "finally dried and heated to 180°."

We would request Dr. Joseph to repeat the following experiment with silica prepared in the manner given above. The silica is washed until the wash water after twenty-four hours' contact shows no opalescence with silver nitrate. It is separated in two equal portions to one of which a definite volume of pure water and to the other a definite volume of saturated solution of potassium nitrate free from chlorides are added respectively. If the two liquids are carefully decanted, the potassium nitrate solution

shows perceptible opalescence with silver nitrate, while the other does not. But if, however, the washing of the silica is carried on for a long time even after the P_H of the wash water has become equal to that of the water used, the potassium nitrate solution fails to show any trace of a chloride.

Regarding the statement in par. 4 of his letter I think Dr. Joseph is scarcely doing me justice in suggesting that these obvious precautions were not taken. The silica or the solutions never came in contact with filter papers. Transparent fused silica vessels were mostly used. Where glass vessels were used (resistance glass) it was ascertained that the results were not due to a reaction with the vessel. We have several times repeated and confirmed our observations.

Dr. Joseph says nothing about the increase in the negative charge of the surface at low concentrations of neutral salts which to my mind definitely proves the primary adsorption of anions and consequently of electrolytes including acids which contain these anions.

Similar experiments have been done with manganese dioxide, corroborating our point of view. We have communicated a paper to the Journal of the Indian Chemical Society, "On the Nature of Hydrolytic Adsorption, Pt. I," in which the theoretical considerations advanced in previous papers have been developed and a brief summary of the results obtained in this laboratory during the last four years has also been given. Full experimental results will be published later.

I would take this opportunity to point out that we distinguish between three types of adsorption: (1) primary adsorption, resulting from the chemical affinity of the atoms on the surface (cf. Langmuir); (2) electrical adsorption; and (3) adsorption of solutes (or rather solutions) resulting from the capacity of the substance to adsorb water. The adsorption referred to in my letter in NATURE of April 4 (p. 497) is of the last-mentioned type and is different from the small amounts of primary adsorption referred to in my letter of January 31.

J. MUKHERJEE.
Physical Chemistry Laboratory,
University College of Science and Technology,
Calcutta.

Gas pressure, Radiation-pressure, and Entropy in the Interior of a Star.

IN the simplest form of Eddington's theory of stellar constitution (*vide* papers in Mon. Not. R.A.S., and *Astrophysical Journal*, 48, 205, 1918), the assumption is made that a certain quantity, β, is constant throughout a given star; β turns out to be the ratio of the gas-pressure to the total pressure (which is the sum of the gas-pressure and the radiation-pressure). The present note shows that the second law of thermodynamics provides a theoretical background for this assumption of Eddington's—justification of which has been largely empirical heretofore.

Write S for the entropy per unit volume at any point within a star, n for the number of molecules per unit volume, dV for a volume-element, and V for the total volume of the star. A feature of Eddington's method is that the volume, V, and the total number of molecules, $\int n\,dV$ (total mass divided by molecular weight), are supposed—at a certain point in the solution—to be given. Now S may be taken as a function of the two independent variables, V and n. Suppose that the distribution of matter within the star is infinitesimally varied, subject to the two restrictions mentioned, so that

$$\delta V = \delta\int dV = 0 \qquad (1)$$

and

$$\int \delta n\, dV = 0 \qquad (2)$$

where the integrations are performed throughout the entire volume of the star. The condition for stable equilibrium is that the total entropy is a maximum, or

$$\delta\int S\, dV = 0 \qquad (3)$$

In consequence of (1), this is equivalent to

$$\int \frac{\partial S}{\partial n}\delta n\, dV = 0 \qquad (4)$$

Comparison of (4) and (2) necessitates that

$$\frac{\partial S}{\partial n} = b, \qquad (5)$$

a constant throughout V.

It remains to express the relation between b and β. Taking the entropy as that of the radiation alone,

$$S = \frac{4}{3}aT^3 = \frac{4p'}{T},$$

where T is the absolute temperature of the elemental region, aT^4 the radiant energy per unit volume, and p' the radiation-pressure. Since the gas-pressure, p, is given by nRT (where R is the gas-constant per molecule),

$$S = 4nRp'/p \qquad (6)$$

Comparing with (5),

$$b = \frac{4Rp'}{p} = 4R\frac{1-\beta}{\beta},$$

and β is constant throughout the star.

This treatment neglects the entropy of the gas. Furthermore, owing to varying ionisation with the varying distributions of matter, (2) above is only an approximation. Consequently the way is left open for more refined theories, according to which β and b may not be constant throughout a given star.

JOHN Q. STEWART.
Princeton University Observatory,
July 28.

The Experimental Transmission of Cutaneous Leishmaniasis to Man from *Phlebotomus papatasii*.

SERGENT, ED. et ET., Parrot, L., Donatien, H. and Beguet, M. (C.R. Acad. Sci., vol. 173, No. 21, pp. 1030-1032), first successfully transmitted cutaneous Leishmaniasis to man from sandflies. Their experiment consisted of dividing a batch of 559 sandflies into 23 batches, crushing the sandflies in saline, and inoculating scarified points on the arms of volunteers. The sandflies were caught in Biskra, an endemic centre of cutaneous Leishmaniasis, and the experiment was performed in Algiers, where locally acquired cases of the disease are unknown. One experiment (from a batch of 7 specimens of *Phlebotomus papatasii*) was successful, Leishman-Donovan bodies being found from a papule which appeared 2 months and 24 days after the experiment.

A batch of 198 sandflies (191 *Phlebotomus papatasii*, 16 ♂♂ and 175 ♀♀, 7 *P. minutus* 1 ♂ and 6 ♀♀) were caught in Jericho on June 25 last, and brought to Jerusalem for dissection. On June 26 a female *Phlebotomus papatasii* was found heavily infected with Herpetomonas flagellates being present in the œsophagus, œsophageal diverticulum, midgut, and hindgut. The alimentary tract contained no trace of blood and the abdomen was full of ripe or almost ripe eggs. A large number of the flagellates were found attached to the under surface of the œsophageal

valve. Only fully developed flagellates were present, and Leishmaniasis form parasites and intermediate forms were not observed. A part of the material was stained and mounted and the remainder was used for the experiment. Two points on the left forearm of a volunteer were scarified and inoculated with material containing flagellates on June 26. On July 31 a small papule which would normally have passed unobserved was noted on one of the inoculated points and on examination Leishman-Donovan bodies were found, *i.e.* the incubation period was less than half of that noted by the Sergents and their collaborators. Nothing was noted on the other site of the inoculation, but it was examined and up to the time of writing has proved negative.

It must be further noted that the insect from which the material for the experiment was obtained was the only one from the batch of 198 which contained Herpetomonas.

The method of dissecting individual sandflies and experimenting with a positive individual is more satisfactory than crushing batches in saline and experimenting with the product, for in the latter case it is impossible to know whether a negative result is due to the fact that the sandflies contained no Herpetomonas or whether the Herpetomonas was non-infective.

For various reasons we do not think that the successful experiment of the Sergents and collaborators and our own experiment provide a complete explanation of the etiology of cutaneous Leishmaniasis, and we intend to discuss this point elsewhere. It must be pointed out that Patton has on several occasions pointed out the necessity of the experiment performed by the authors (Bull. Soc. Path. Exot., vol. 12, No. 8, pp. 500-504, and *Ind. Jour. Med. Res.*, vol. 9, No. 3, pp. 496-532).

S. ADLER.
O. THEODOR.

Microbiological Institute, Jerusalem,
P.O.B. 250, August 5.

Spiral Springs of Quartz

MAY I express my interest in your recent correspondence on quartz spiral springs (NATURE, June 20, p. 943, and July 4, p. 14), and suggest a convenient laboratory method for the production of springs of extreme sensitivity. I refer to the use of fibres the diameter of which is 10^{-3} cm. or so.

One end of a length of fibre is weighted and the other attached to a transparent quartz tube by fusion. This is accomplished simply, by heating to incandescence a small portion of the tube in an oxy-gas flame and quickly lowering the heated spot on to the fibre, which is held at right angles to the axis of the tube. A perfectly strong joint is made and the loaded fibre may be wound up at the desired pitch (difficulties arise owing to air-currents if the tube is not lowered on to the fibre). A similar procedure serves to finish off the spiral; a small portion of the tube, say 1 cm. away from the windings, is heated to incandescence and, tilting the tube, the last turn of the spiral is wound over the hot spot. The spiral with its supporting tube is now placed axially in a wire-wound resistance furnace and heated rapidly in air above the annealing point of fused silica—1 minute at 1100° C. is adequate for a fibre 10^{-3} cm. diameter wound on a diameter of 1 cm. No trouble from devitrification is experienced and the elastic properties of the fibres are unimpaired; moreover, the curvature of the coil is uniform throughout.

Removal is best accomplished by unwinding slightly one of the end turns of the spiral, bending it outwards from the tube and away from the coils. In this position the end may be secured to a rigid support by any suitable adhesive, the remaining turns being similarly opened and wound off. In this process a single camel hair is useful to guide the motion of the fibre, and is best used without artificial aid to vision. As an example of sensitivity, a spring so made with which I have experimented has an expansion rate of 3×10^{4} cm. per gram, this measured by deformation under its own weight.

By careful regulation of the time and temperature of heating, a coil may be made, which, when released at its ends, is of larger diameter than the tube on which it was wound. Incidentally, this technique for producing springs of varying curvature, under specified conditions of time and temperature, offers a very convenient method for the study of the annealing of vitreous bodies, since a simple series of experiments gives quantitative information as to the time rate of the release of strain.

H. D. H. DRANE.

Research Dept., Thermal Syndicate,
Wallsend.

Fish Poisons as Insecticides

THE destruction of fresh-water fish by means of the poisonous properties of certain plants is almost as widespread as the use of the conventional form of fish trap in one or other of its common modifications. Like the savages of many tropical countries, the poachers of Southern Ireland employ a vegetable fish poison, and this they obtain from spurge (*Euphorbia hibernica*). The primitive method of use is merely to put the freshly gathered plant (leaves, stem, and root) into a sack and tread on this vigorously in the shallow water at the head of a pool. The expressed juices mingle with the water and rapidly render all fish helpless for, it may be, three-quarters of a mile downstream. It is said that affected fish never recover, and the amount of destruction wrought, especially in streams where quantities of salmon parr and small trout exist, can easily be imagined.

The more modern method of application is, I understand, to crush and chop the plant in a chaff cutter or some similar agricultural machine, collect the juice in a bottle, and put this into the stream either with or without the chopped-up plant.

If it were found that the spurge poison is also valuable as an insecticide, the plant would probably be more easily obtained, or cultivated, than some of the tropical forms.

Flax water, the scourge of certain rivers in Northern Ireland, is in its effects at least as deadly as spurge, but its effect is due to the product of the decomposition of the softer parts of the flax plant in water and not the juice of the plant itself.

W. J. M. MENZIES.

Fishery Board for Scotland,
Edinburgh, August 17.

The Word "Australopithecus" and Others

NEITHER Dr. Bather nor Dr. Allen (NATURE, June 20, p. 947, July 25, p. 135) directs attention to the fact that the names of all well-regulated families or subfamilies should be based on a generic name, so that the term Homosimiidæ is ill advised. As for the name Australopithecus and any other combinations, it might be said that scientific names are not strictly speaking, literature, though so regarded by the orthodox. Many years ago Le Conte, to show that a name need not necessarily mean anything, gave the name Guyascutus to a genus of beetle.

F. A. LUCAS,
Honorary Director.

The American Museum of Natural History,
New York City, August 6.

Moseley's Work on X-rays

By Sir ERNEST RUTHERFORD, O M , F R S

TO the many friends of the late H G J Moseley, who was killed in action at Gallipoli in 1915, it has always been a matter of regret that no reasonable portrait of him could be found Apparently Moseley had an objection to placing himself in the hands of the professional photographer Recently, Mr N Garrod Thomas kindly sent me the negative of a snapshot of Moseley taken probably in the Balliol-Lincoln Laboratories at Oxford in the summer of 1910, about the time of his graduation and before he took up a post as lecturer in physics in the University of Manchester A part of this negative has been enlarged by Mr W H Hayles, of the Cavendish Laboratory, and is here reproduced[1] I think all will agree this is an admirable portrait of Moseley It is difficult to be certain of the apparatus in his hands, but it may have been connected with a repetition of some of the expansion experiments of Prof C T R Wilson, which it is known he carried out about that time

Henry Gwyn Jeffreys Moseley, 1887–1915

In an obituary notice in this journal (Sept 9, 1915), and also in a special notice in the Proceedings of the Royal Society in 1916, I gave an account of Moseley's life and work, and directed attention to the fundamental importance of his two papers published in the *Philosophical Magazine* (Dec 1913, April 1914), entitled "The High Frequency Spectra of the Elements" In these papers he formulated for the first time the law, now known as Moseley's Law, governing the X-ray spectra of the elements, and by its aid was able to fix definitely the number and order of the elements While the importance of these brilliant researches was immediately recognised, now that a decade has elapsed we can appreciate even more clearly the significance and fundamental character of his discoveries and can estimate the extent to which his work has influenced the development of modern physics

In this connexion it may not be inappropriate to recall briefly the theoretical position at the moment Moseley began his investigation and the subsequent developments The nuclear theory of the atom had been advanced in 1911, and from the results of experiments on the scattering of α rays, it had been suggested that the nuclear charge of an atom might be given by the atomic or ordinal number of the element On the nuclear theory, the properties of an atom are defined mainly by its nuclear charge, since this controls the number and arrangement of the outer electrons

Following the discovery in 1912 by Laue, Friedrich, and Knipping of the diffraction of X-rays by crystals, W H and W L Bragg in 1913 had found evidence by the electric method of the presence of bright lines in the spectrum of platinum, using the method of reflection of crystal faces These results were confirmed and extended by an investigation by Moseley and Darwin, published in the same year

At this stage I remember well a discussion with Moseley, in which he proposed a research to test whether an examination of the X-ray spectra of a group of elements could give a decisive answer to the question whether the properties of an atom are defined by its atomic number, as suggested by the nuclear theory, or by its atomic weight, as indicated by the periodic law of the elements As we know, his hopes were strikingly verified He rapidly examined by the photographic method the K spectra of a group of the lighter elements and the L spectra of a number of the heavier elements The conclusions reached by Moseley are clearly given in the terse summary in his second paper, which for its interest is reproduced here

1 Every element from aluminium to gold is characterised by an integer N, which determines its X-ray spectrum Every detail in the spectrum of an element can therefore be predicted from the spectra of its neighbours

2 This integer N, the atomic number of the element, is identified with the number of units of positive units of electricity contained in the atomic nucleus

3 The atomic numbers for all elements from Al to Au have been tabulated on the assumption that N for Al is 13

[1] I have arranged with Mr Hayles to provide copies of this enlargement at a small charge

4. The order of the atomic numbers is the same as that of the atomic weights, except where the latter disagrees with the order of the chemical properties.

5. Known elements correspond with all the numbers between 13 and 79 except three. There are here three possible elements still undiscovered.

6. The frequency of any line in the X-ray spectrum is approximately proportional to $A(N-b)^2$, where A and b are constants.

Apart from (2), the conclusions drawn in Moseley's paper are a straightforward interpretation of the experimental facts and involve no theoretical assumption as to the nature of radiation or the structure of the atom.

Moseley's identification of the atomic number as a measure of the nuclear charge afforded an interpretation of the frequency law he had found in accord with Bohr's quantum theory of spectra, which had been published previously. The correctness of this identification has since been verified by Chadwick by direct measurement of the scattering of α rays by the nucleus.

As a result of these brilliant experiments of Moseley, a relation of unexpected simplicity is seen to hold for all the elements. The properties of an atom are defined by a whole number which represents the ordinal or atomic number of the element and, at the same time, its nuclear charge and the number of electrons external to the nucleus. The atomic weight turns out to be in a sense a secondary property and the periodic law of the elements is put on a wider and more philosophical basis by the substitution of the atomic number or nuclear charge for the atomic weight of the atom.

The work of Moseley has formed a solid and indispensable foundation for the subsequent attack by an army of researchers of the great problem of the constitution of the outer atom. His frequency law has proved an invaluable aid in interpreting the intricacies of X-ray spectra and their relation with atomic constitutions—a subject on which so much fine work has been done in recent years.

We have seen that Moseley showed that all possible elements, disregarding isotopes, had been discovered up to number 79 except three[2] numbers 43, 61 and 75, and he stated "as the X-ray spectra of these elements can be confidently predicted, they should not be difficult to find." The study of the X-ray spectra affords a powerful and unique method of chemical analysis of a mixture of elements; subsequent research has shown that the presence of an element can be detected with certainty and its amount estimated by its X-ray spectrum even if it be present only to the extent of one part in a thousand. The first of these missing elements found by this method, namely, number 72, was called hafnium by Hevesy and Coster. In this case the method of X-ray analysis was all-important since hafnium is always found with zirconium, with which it is chemically so closely allied that separation is very difficult.

If the other missing elements existed in appreciable amount in minerals, their detection seemed certain. A few weeks ago it was announced by Dr. Noddack and Fraulein Tacke that the missing elements 43 and 75 had been identified by their X-ray spectra in material separated from certain platinum minerals. A preliminary account of their investigations has been given in this journal of July 11. One element, 61, in the rare earths remains unidentified; but for this, Moseley's list of numbers is complete from 1 to 84.

Moseley had the spirit and courage of the true pioneer in science, coupled with great original ability and powers of work. It is rare in the history of science that so young a man has achieved so much.

[2] In making this statement Moseley assumed that number 72 had already been filled by a rare earth element celtium. As we now know number 72 had not been isolated at the time Moseley wrote. There were not three but four gaps.

Concerning the Rate of Man's Evolution[1]

By Sir ARTHUR KEITH, F.R.S.

BEFORE proceeding to discuss my subject—"The Rate of Man's Evolution"—it may be well to ask the question: Is evolution at work in England to-day? Are the Londoners of to-day taller than those of two, ten, or twenty centuries ago? Any one who sets out to answer this simple question is brought face to face with the difficulties which encompass the inquiries of the student of man's evolution. His difficulties are those of variability. The men and women we meet on the streets are of varying height; to strike a true average for the stature of Londoners we must measure hundreds of individuals in every district of this great city. Nor would our average for London hold for the men and women of Birmingham, Manchester and Newcastle, nor would the averages for these cities hold for their surrounding districts. To know the average stature of men and women now living in England entails the measurement of many thousand individuals.

Until the War we believed that the average Englishman stood 5 ft. 8 in. in height; figures gathered then compel us to reduce our estimate by nearly 2 in. When we search the ancient graveyards and burial-places of England to ascertain the average stature of the men and women buried in them, our difficulties are even greater. The people buried in ancient tombs differed in height just as much as we do; the numbers available for measurement are limited; we have to estimate stature from the length of their limb bones. If we are uncertain of our modern stature, we are still less certain of that of former times. Still, if for the moment we dispense with the precision of the biometrician, we may say that there has been no great change in the stature of the inhabitants of these islands since the close of the Ice Age, some 12,000 years ago. There have been "ups and downs," but the mean for modern Englishmen of 5 ft. 6 in. may be taken as the pivot on which the scales of stature have been balanced for thousands of years.

When we apply measurement to the size and form of head, and compare the dimensions of modern Englishmen with those of former times, we are again confronted with the perplexities of variability. In the third millennium B.C. the skulls of England were long and narrow. About the beginning of the second millennium the eastern and southern parts were settled by a people with short and wide skulls; in the first millennium,

[1] Discourse delivered at the Royal Institution on Friday, March 6.

probably as a result of a new influx the long and narrow skull again asserted itself In Roman times, and more particularly in Saxon times, the long and narrow skull prevailed Measurements made on living Englishmen lead to the belief that the head-form has changed and is changing—becoming slightly shorter and slightly wider There is evidence of a similar change in the head-form of the people in Egypt So far as concerns the brain-capacity of the skull there is no evidence of increase From the limited data at our disposal we must infer that the people who occupied western Europe at the close of the Ice Age stood distinctly above their successors of to-day in the matter of brain-size

I have said that in certain details of bodily structure the Egyptians of to-day do differ from the men who built the great pyramids some 5000 years ago This, however, is not the accepted opinion Those who maintain that modern man has ceased to evolve cite the similarity between modern and ancient Egyptians to prove their contention Only ten years ago I was of opinion that the evidence from England led to the same conclusion My opinion was altered by certain investigations I carried out in 1914–15 I took fifty skulls (twenty-five of men and twenty-five of women) from English graves which were known to be 1000 years old or more, some of them were as ancient as the pyramids I instituted a minute comparison between these ancient skulls and those of corresponding numbers of men and women who had lived in England during the eighteenth and nineteenth centuries

The result of this comparison was to convince me that evolution is now at work on our bodies The chief change is to be seen in the size and shape of the palate, the roof of the mouth tends to become reduced in size and to become narrower The bony entrance to the nose shows alterations It tends to become narrower and its lower margin to rise up so as to form a sharp bony sill The jaws recede and the bony framework of the nose becomes more prominent The sockets for the eyes become changed in form, the lower margin or sill of the orbit tends to sink downwards in the face, thus increasing the distance between the lower and upper margins of the orbit At the same time the orbits become narrower from side to side, the breadth across the upper part of the face becomes less The cheek bones lose their prominence and there is a tendency for the face to grow narrower and longer

It may be said that the changes I have described are due to a diminished use of the jaws in modern people, for the jaws form a large and intrinsic part of the face, and any reduction in size and strength in jaws must necessarily alter the whole face I do not think we can accept a diminished use of the jaws as a true explanation, for this reason The changes which I have described are confined to about 30 per cent of the modern population, 70 per cent show no such change, and yet all live on approximately the same dietary The cause lies deeper than a mere disuse of jaws, certain stocks and families show these changes to a more marked degree and more frequently than do other stocks and families Such evidence as I have gathered points to an increasing frequency of these new characters during recent centuries Apparently evolution makes its conquests in the way just described, progress is made by climbing the scale of percentages

The result of this investigation took me rather by surprise, for I had been of opinion that men of our type had lived in England for a hundred thousand years or more and retained their essential characters almost unchanged This belief was founded on a famous discovery made at Galley Hill in 1888 The schoolhouse of Galley Hill occupies a bluff on the southern bank of the Thames, half-way between Dartford and Gravesend Standing by the schoolhouse we look northwards across the valley to the flat lands of Essex, Tilbury docks, the scene of another famous discovery of ancient human remains, is clearly visible on the far bank of the river The bluff on which the schoolhouse stands rises 100 feet above the level of the river, between the bluff and the river lies a stretch of marsh fully a mile wide On the bluff, close by the schoolhouse, is a pit, dug by cement-workers, now disused, but a busy place in 1888 The workmen had exposed a series of beds, consisting of gravel, sand and loam, which extended downwards fully 10 feet below the surface soil In the lowest bed but one the workmen began to expose parts of a human skeleton, it lay 8 feet below the original surface At the same level large primitive flint implements had frequently been found Was the skeleton thus discovered the remains of one who had helped to fabricate these instruments?

Over the skeleton the original beds were seen to be intact, if there had been a burial, these beds should have shown definite signs of having been broken The workmen and two other observers, who examined the section while some of the bones were still untouched, were convinced that the skeleton had become naturally entombed when the beds of sand and gravel were being formed As to the man thus brought to light there can be no doubt I have spent many hours in examining his bones His skull, jaws and limb bones are marked by certain primitive features, but every one of these can be matched in the skeletons of men who are living in England to-day or have lived in recent times Galley Hill man was of the modern European type [2]

Try as I could I did not see how the geological evidence at Galley Hill could be set aside, and I accepted the inevitable conclusion that Galley Hill man was as old as the strata in which he lay How old are these strata? They are records of the ancient history of the Thames valley The river made the valley and wrote its records The gravel deposits on the bluff at Galley Hill are but a fragment of the terraces which fringe both sides of the valley of the Thames at the 100 feet level These fringing terraces were laid down in the bed of the river or on the shores of its estuary They tell of a time when the land on which the older and richer parts of Westminster and London now stand lay fathoms beneath the waters of the estuary, and buried deeply by the deposits which accumulated as tides flowed and ebbed

Geologists recognise other and later terraces of the Thames valley There is an extensive series at the 50 feet level Piccadilly runs along this terrace, the foundations of the Royal Institution penetrate its sands, gravels and loams There are still later deposits of the 25 feet terrace The Admiralty Buildings, the Houses of Parliament and the Horse Guards stand on this

[2] The circumstances of this discovery and the characters of the skeleton are discussed in my "Antiquity of Man," second edition 1925

terrace. We find in this terrace deposits which mark the close of the Ice Age in England, a date which geologists regard as about 10 000 or 12,000 years distance from us. It is clear, then, that much has happened in the valley of the Thames since the river began to lay down the deposits which make up the 100 feet terrace. If geologists did think in terms of years there are few who would limit the history of this period of the Thames valley to a term of 100,000 years; many, I am sure, would demand twice this sum. If Galley Hill man is as old as the deposit in which his bones lie, then the rate of man's evolution has been so slow as to be almost imperceptible.

In recent years a new light has been thrown on the history of the Thames valley by a simple discovery. Women know that every hat and coat is dated by its cut or design; they believe that fashion began her imperious sway in modern times. Archæologists and geologists groping amongst the dust heaps of the past have found that mankind has always been the slave of fashion. At all times man has shaped his implements according to the prevailing fashion of the place and period. His handiwork is just as datable as are our hats and houses. French archæologists, when they began to explore their caves methodically some sixty years ago, made this discovery; they began to work out the sequence of fashions. It was soon found that the system discovered in caves could be applied to the deposits or terraces of river valleys. The fashions of the river valleys went a long way further into the past than did those of the caves. The deposits of the 100 feet terrace of the Thames valley, for example, were found to contain fashions of three consecutive periods. For the deepest and oldest bed of all implements were worked in a pre-Chellean manner; in the strata just over the burial bed of Galley Hill man implements were of full Chellean workmanship; in the more superficial strata they were worked in the Acheulean manner. Thus, if we admit that Galley Hill man is truly of the same age as the 100 feet terrace, then his culture is that of Chellean man. The implements of this period often show evidence of high skill in the working of flint.

When the fossil remains of Galley Hill man were discovered, we had only geological data to assist us in fixing their antiquity. Since then a new source of evidence has come to light. In the deposits on the sides of our valley—in the strata of its terraces—there is a complete sequence of the cultural phases of the Pleistocene period. We can trace all the stages which link the cultural debris now being entombed by the Thames in its bed to the pre-Chellean implements which were engulfed when the deepest and oldest stratum of the 100 feet terrace was deposited. Galley Hill man lay in the middle or Chellean strata of that terrace. Those who have studied the sequence of Pleistocene cultures, and have assigned just estimates to each, suppose that the Chellean phase of culture was moving towards its zenith 100,000 years ago. If we base the age of Galley Hill man on cultural evidence, we have to assign to him an antiquity of 100,000 years. If we accept this age, then we have to infer that the type of man now found in Western Europe has come through the greater part of the Pleistocene period without undergoing any great degree of change.

Let us now look at the evidence relating to man's antiquity which has been accumulating these past years on the continent of Europe. The Neanderthal type of man, which we are to investigate first, belongs to the Mousterian phase of culture, one which is much more recent than the Chellean. Most authorities would date the beginning of the Mousterian phase at about 40,000 B.C., and its concluding phase as about 20,000 B.C. All the graves of this long period—from Gibraltar in the south to the centre of Germany in the north—contain remains of only one type of man, the primitive Neanderthal type. The bones of the modern type—Neanthropic man—are never met with. We must thus conclude that the European of the long Mousterian period was Neanderthal man.

Further, the discoveries made at Ehringsdorf, near Weimar, and in the Mauer sands near Heidelberg, have revealed older and more primitive representatives of the Neanderthal type. Heidelberg man is as old as the deepest bed of the 100 feet terrace of the Thames valley; he belongs to the opening phase of the Pleistocene period. Thus all the evidence from the continent leads us to believe that Europe was inhabited by men of the Neanderthal type throughout the greater part of the Pleistocene period. They underwent a considerable degree of evolution before their type was extinguished at the end of the Mousterian period. There are only two items of evidence which clash with this interpretation—namely, the discovery made at Galley Hill, and another at Clichy, in Paris, where human remains, very similar to those of Galley Hill, were found in a stratum of Chellean date.

All authorities are now agreed that the Mousterian period closed some 20,000 years B.C. with the sudden appearance in Europe of men of the modern type. These forerunners of the modern European were big-brained fellows, in every respect of our own type, save that all of them were strong-jawed and had countenances cast in a somewhat rugged mould. A little toning down of these characters would convert them into modern Europeans. It is clear that these forerunners which broke into Europe at the end of the Mousterian period had evolved elsewhere. We have not yet found their cradle-land. I suspect that it will be found in the northern stretches of the Sahara, or perhaps farther to the east—in Arabia or Southern Turkestan. If only we could discover the prototype of the European and assign a geological date to it, we should settle once and for all whether it was possible for men of the modern type to have made a settlement of Europe during the Chellean period, from which they were afterwards expelled by Neanderthal man, or whether his first appearance in Europe was that made at the end of the Mousterian period, when he conquered and extinguished Neanderthal man. If we accept the first alternative, then the evolution of the European type has been slow; if we accept the second, then it has been more rapid. Circumstances force me towards accepting the latter alternative.

Let us turn for a moment to another representative of mankind at the beginning of the Pleistocene period—Piltdown man. I think we are all agreed that his culture was pre-Chellean, and that his period is represented by the deepest and oldest bed of the 100 feet terrace. He thus belongs to an older and more primitive cultural period than that of Galley Hill man. In

form of skull and in size and pattern of brain, this early representative of Pleistocene humanity does not differ markedly from living races; if not actually on our line of descent, the Piltdown type cannot be far removed from it. The anthropoid characteristics of his jaws and teeth are the chief obstacles to placing the Piltdown type on the direct line of our ancestry. We may presume, however, that our direct ancestor had reached as high a stage at the dawn of the Pleistocene period as that attained by Piltdown man. Even then evolution must work with some rapidity if the modern European is to be produced before the Pleistocene period had closed.

We must also take into consideration that remarkable fossil type of man discovered in Java, to which the name Pithecanthropus has been given. We may accept the date ascribed to him by his discoverer, Dr. Dubois, as late Pliocene. He is thus older than either Piltdown man or Heidelberg man. His brain possessed distinctively human features, but it is much smaller, much less evolved than any hitherto ascribed to man. His skull and his brain, so far as we know them, stand midway between the status of ape and man. To transform this ancient type of Java into the most primitive of living human types, evolution would have to proceed at an extremely quick pace. It is easier to believe that Pithecanthropus represents the persistence of an early Pliocene type than that it represents the stage reached in human evolution at the end of that period.

The discovery made in the Broken Hill mine, South Rhodesia, in the autumn of 1921, must also be taken into account. Here was brought to light the fossil remains of a primitive human type. Rhodesian man may be described as the cousin of Neanderthal man, but was more primitive in many respects than any example of Neanderthal man so far found in Europe. Neither the geological nor the cultural age of Rhodesian man is fixed as yet, but we shall not over-estimate his antiquity if we make him a contemporary of the men who lived in Europe at the beginning of the Mousterian period. Neanderthal man became extinct; he was not transformed into modern man. In this respect Rhodesian man differs from him; he could stand very well as an ancestor to men of the Australoid type; he might be on the line along which modern races have evolved. To transform the Rhodesian into the Australoid type within the compass of the Pleistocene period demands a moderately rapid progress; to transform the Rhodesian type into that of the modern European in this space of time would require evolution to move at a rapid rate.

The important discovery which Prof. Dart has made at Taungs, Bechuanaland, has no bearing on the problem we are discussing here. He has found the fossil remains of a young anthropoid ape; it is akin to the chimpanzee and to the gorilla. This discovery throws light on the history of anthropoid apes and upon their evolutionary proclivities, but not, I think, upon the pedigree of humanity.

I have stated the chief facts on which anthropologists have to base their judgment as to the rate at which man has come by the present characters of his body and brain. We are all agreed as to the primitive nature of the human types discovered at Piltdown, Heidelberg, Java and Rhodesia. There is also a broad agreement as to the early dates at which these types lived. If they represent the general stage which evolving humanity had reached in the opening phase of the Pleistocene period, then we must count that man's ascent to his present place has been one of rapid progress. On the other hand, we have the discoveries at Galley Hill and Clichy. The men found in those instances are of our type; if we accept the geological evidence, we have to presume that, so far as our ancestry is concerned, evolution has been stationary throughout the greater part of the Pleistocene period. As evidence accumulates, it becomes easier to reject the geological evidence relating to the discoveries at Galley Hill and Clichy, and more difficult to believe that man in his full-blown modern form could have been the contemporary of the uncouth types discovered at Piltdown, Heidelberg, Java and Rhodesia. In brief, the evidence which accumulates forces us to the conclusion that the evolution of man has been more rapid than many of us have hitherto believed.

I began by showing how much our anthropological inquiries are complicated by the rank degree of variability which prevails among all races of mankind. The same difficulty confronts us when we set out to search for our Pleistocene ancestry. The world of to-day is populated with races of the most diverse types. It was so in remote times, only the population was then sparse and scattered, and the racial types were infinitely more divergent than they now are. Of the early fossil types so far discovered only one—the Rhodesian man—has any claim to a place in the direct lineage of modern races. The stages which lead on to man of the Indo-European or Caucasian type have not been found as yet. It is not until we have unearthed these missing stages that we shall be in a position to pass a final judgment on the rate of man's evolution.

Current Topics and Events

ON July 3 a deputation from the Australian National Research Council waited upon the Prime Minister of the Commonwealth to present a strong protest against acquiescence in the annexation by France of the Antarctic territory of Adelie Land, an action which was announced by French Presidential decree on November 24, 1924. On behalf of the Council, Sir David Masson (president) pointed out that since 1840, when d'Urville sighted and named, but did not land upon, Adelie Land, no attention has been given by France to this region. British expeditions, on the other hand, costing money and life, have made important additions to scientific knowledge of what, from its geographical position, has come to be known as the "Australian Sector." On the Mawson Expedition of 1911–14, which added 1000 miles of coastline to the map, Australia has already spent 70,000*l*., and elaboration and publication of valuable results is still in progress. To no other country will further investigation of this sector be of such interest and significance. The progress of meteorological science, for example, will probably make the establishment of observing stations exceedingly important for Australia, for it must be remembered that Adelie Land, due

south of Adelaide is nearer to Hobart (1467 nautical miles) than Hobart is to Perth. Economically, too, these lands must become of great value, and the framing and administering of laws regulating the exploitation of seals, whales, and other life in the neighbouring seas are matters urgently requiring attention. The question is whether France or Australia is the proper authority to take the required action.

There being no accepted international law in the matter of the administration of unclaimed polar territory, the Australian National Research Council urged the adoption of the principle applied by Canada in 1886 to Arctic lands. In effect this is that unclaimed polar lands should be administered by the most closely adjacent civilised Government. The assignment to Canada of the area between it and the Pole lying between the Canadian E. and W. meridians of longitude, to Norway of Spitsbergen, and to Russia of Wrangel Island, are all in accord with the principle; so was the establishment of the Falkland Islands Dependency in the Antarctic under British rule, and of the Ross Dependency under New Zealand (July 30, 1923). It is now proposed that Australia should claim international sanction for the administration of the whole of that part of the Antarctic continent between 90° E. and 160° E., and it was pointed out on behalf of the deputation to the Prime Minister of the Commonwealth that on the same principle, France would be justified in claiming an area lying to the south of her various island possessions in the southern hemisphere. The whole matter is arousing considerable interest in Australia, particularly in scientific circles, and it is hoped that the result of Government inquiries and action will be a friendly solution of the difficulty in accordance with the Canadian principle.

The extending use of electricity in agriculture abroad has turned the attention of many supply engineers in Great Britain to the investigation of its possibilities, and a report on the subject has been published in the August Journal of the Institution of Electrical Engineers. The conditions which lead to an economic use of electrical power in farming are different in various countries. In Sweden, for example, the transmission lines from the waterfalls pass along the valleys in which the agricultural areas are situated. In this case, the lines can be readily tapped and the farmers supplied at a low price. In Holland, many lines are in existence traversing agricultural land on their way to supply towns or the electric pumps used for drainage purposes. In Switzerland also the lines supplying the semi-domestic factories can be readily tapped. In France, however, the shortage of man power makes it necessary to use electric power, and military reasons make it advisable to maintain the agricultural areas at their maximum efficiency and make them as attractive as possible to the population, even at the expense of the State. In Italy, there is a superabundance of hydraulic power from the Alps in the summer time when the industrial demand is a minimum and the farming demand is a maximum. Financial assistance is given by the State to rural distribution lines in Italy, Canada, and Scandinavia. In some of the districts abroad the supply is remunerative and some progress has been made in Great Britain. Most electrical engineers believe that the electrical equipment of all our main line railways is merely a question of time. When it is accomplished, there will be many distribution systems in existence from which a supply to agricultural areas could easily be given at remunerative rates. The cost of an overhead system to supply farmers is about 500*l.* per mile; this is mainly due to strict government regulations. In Sweden the cost is sometimes so low as 100*l.* per mile. It looks as if we would have to wait until the advent of electric traction before much progress can be made in applying electricity for the benefit of British agriculture.

The opening meetings of the fifth Congress of the French Society of Chemical Industry will be held at Paris in the second week in October. As part of the proceedings, a special assembly will commemorate on October 11 the one hundredth anniversary of the practical establishment of the soap industry by the French chemist, Michel Eugene Chevreul, who, in 1825, with J. L. Gay-Lussac, started a factory for the manufacture of stearic acid. Through his prolonged scientific researches Chevreul explained the process of saponification. The President of the French Republic, members of the Academy of Sciences, and those of kindred bodies will join in the forthcoming commemorative session. Born at Angers on August 31, 1786, Chevreul died in 1889, at the age of one hundred and three years. At seventeen Chevreul went to Paris, entering Vauquelin's chemical manufactory; ultimately he became director there of the laboratory. Later (1824) he took up the post of Director of the Dyeing Department and professor of dyeing at the tapestry works of the Gobelins. His well-known researches on the principles of harmony and contrast of colours were carried out at this period. In 1864 Chevreul was appointed Director of the Museum at the Jardin des Plantes, retiring in 1879. Elected a foreign member of the Royal Society in 1826, Chevreul was awarded the Copley Medal in 1857. The centenary of the birth of this distinguished chemist was celebrated in Paris with signal honour and many felicitous demonstrations. A great procession to the cathedral of Notre Dame took place on the occasion of Chevreul's funeral in 1889.

According to a message dated August 24 in the *Times*, Capt. Amundsen's ship, the *Maud*, has returned to Nome, Alaska, in charge of Capt. Wisting. It will be remembered that Capt. Amundsen set out in June 1922 with the *Maud*, intending to fly from Wainwright or Point Barrow, Alaska, across the Pole to Spitsbergen, and leaving the *Maud* to drift across the polar basin in the ice. Early in 1923 the position of the *Maud* was reported as lat. 74° N., long. 170° 30′ E., and the most northerly point recorded is now stated to be lat. 77° N., long. 146° W. North-westerly cross-currents prevented the ship from

drifting across the polar basin The party found that polar bears were numerous As is now well known, Capt Amundsen changed his plans for the polar flight and set out from Spitsbergen in May last, returning there on June 18 after having reached lat 87° 44′ N, long 10° 20′ W

WE welcome the appearance of a new German anthropological publication—*Zeitschrift fur Volkerpsychologie*—which revives the title of a publication now defunct It is edited by Dr Richard Thurnwald, the well-known field worker and a sociologist of acknowledged merit One of the objects of the new journal is to keep anthropologists in other countries, especially in England and in the United States of America, in touch with the latest results of continental work It is even hinted that should the number of readers in England and the United States be sufficient, papers and reviews in English will be included in the contents As an earnest of its international aim it may be mentioned that the editorial staff includes Dr Malinowski who is reader in social anthropology at the London School of Economics and Political Science, University of London Should it be possible for the policy outlined by its editors to be carried out, the *Zeitschrift* should fill a serious gap The loss by Germany of her colonies has brought about a serious curtailment of the sum total of the opportunities for and encouragement of anthropological research, which was a prominent feature in German public policy The several annual expeditions fitted out by the Kolonialamt have necessarily ceased, and the publication of the *Mittheilungen aus den Deutsch-schutzgebieten*, the activities and publications of the Hamburg Institute, as well as of the many museums in the principal cities are now no more, or exist only in an attenuated form It is not without misgivings that the British anthropologist views the disappearance in those territories now mandated of the official or officially encouraged study of the primitive population In this respect, however, the mandated territories are unfortunately, in no different case from most of the dependencies of the British empire

THE thirteenth annual meeting of the Indian Science Congress will be held in Bombay on January 4-9 next Sir Leslie Wilson, Governor of Bombay, has consented to be patron of the meeting, and Mr A Howard, Director of the Institute of Plant Industry, Indore, will be president The Congress will meet in nine sections dealing with agriculture, mathematics and physics, chemistry, zoology, botany, geology, anthropology, medical and veterinary research, and psychology respectively Papers to be presented at the meeting should be forwarded to the general secretary, S P Agharkar, 35 Ballygunj Circular Road, Calcutta, or to the president of the appropriate section, with a short abstract, not later than October 15, for submission to the Sectional Publication Committees, not more than ten minutes will be allowed for the reading of any paper The local secretaries for meeting will be Prof G R Paranjape, professor of physics, Royal Institute of Science, and Principal A J Turner, Victoria Jubilee Technical Institute, P O Matunga, Bombay, to whom all inquiries as to accommodation should be addressed

THE Soviet of Commissars of the U S S R decided on July 28 that for all foreign visitors invited to the celebration of the bicentenary of the Russian Academy of Sciences, arrangements should be made for free travel on all the railways and waterways of the Union, for sleeping-cars on the direct communication routes, for seats and for first-class cabin accommodation on all the sea and river steamers from August 15 until October 1 These facilities will depend on the production of a foreign passport, with the visa of the plenipotentiary representatives of the Union abroad, or of the general consulates of the U S S R, with the inscription, "For the celebration of the Academy of Sciences" Besides free travel facilities, the production of a passport and visa thus inscribed will also obtain, without waiting, reserved seats in express trains, and luggage transport These passports will thus be considered in the present case equal to the yearly certificates of members of the Central Executive Committee of the U S S R Special Reception Committees at the frontier stations (including Odessa) will meet foreign guests proceeding to the celebration as soon as they disembark, and assist in getting the necessary tickets or reserved seats without delay

THE death on July 29, at the age of eighty-seven years, is announced of Prof H Hildebrand Hildebrandsson, the distinguished meteorologist who was formerly Director of the Meteorological Observatory at the University of Upsala

WE much regret to announce the death on August 20, at the age of seventy-nine years, of the Right Hon Sir George D Taubman Goldie, K C M G, F R S, who may be rightly regarded as the founder of Nigeria When quite a young man, Goldie travelled extensively in Africa, and in 1877 visited the middle and lower Niger, where British traders had already secured a somewhat precarious foothold depending on the caprice of the river chieftains Goldie realised quickly the potential value of the region, and set to work to develop a system of government which would afford peace and security for both natives and traders, consideration of native rights being prominent, as in all Goldie's dealings with the negroes By 1879 he had amalgamated the trading companies on the Niger into a single company, and two years later he applied unsuccessfully to the British Government for a charter which would have given the company practically sovereign powers Goldie pursued his course in spite of this set-back, buying out in 1884 some French companies which had established themselves on the Niger His efforts were rewarded in 1886, when the Niger Company was established, with Lord Aberdare as governor and Goldie as vice-governor, after some four hundred political treaties with native chieftains had been concluded Goldie's schemes were opposed to the aims of the German Colonial Society, backed by Prince Bismarck, but

British interests prevailed, and in 1898 Nigeria was secured to Britain. In 1900 the administration was taken over from the Niger Company by the Imperial Government, and Sir George Goldie took no further share in the administration of the country. Sir George was president of the Royal Geographical Society from 1905 until 1908, and was elected a fellow of the Royal Society in 1902.

THE June issue of the Journal of the American Museum of Natural History, New York, affords a good example of the means by which the Museum keeps in touch with its 8000 members who receive the Journal bi-monthly as one of their privileges of membership. Of the nine articles, each of about ten or twelve pages, we have space to refer only to three or four. Prof. Ulric Dahlgren describes in clear non-technical language the "ear" of a katydid situated in the tibia of the front leg, the structure of the tympana on which the sound waves impinge, and the nervous elements by which the impression is transmitted towards the brain. An article by the glass modeller of the Museum, H. O. Mueller, gives the reader a fair idea of the stages in the preparation of models of rotifers and Utricularia which are excellent examples of his technique. Dr. E. W. Gudger brings together a number of instances of spiders attacking and feeding upon fishes, frogs, lizards, birds, and small mammals, and Dr. W. G. van Name in "an instance where evolution has turned backward" gives a readable account of ascidians. The illustrations are, as is usual in the Journal, beautifully reproduced, and include a series by Dr. R. W. Miner representing some of the groups of invertebrates exhibited in the Darwin Hall of the Museum, *e.g.*, as seen on the sea bottom in Vineyard Sound, in a tide pool, on wharf piles, and in sand.

THE Geological Survey of the Union of South Africa has just issued Memoir No. 19 on the Inland Coalfields of Natal, by W. J. Wybergh. This memoir describes the three important coalfields of Natal, the Klip River coalfield, the Vryheid coalfield, and the Utrecht coalfield, giving descriptions in each case of the general surface contours, of the geology of the field, the general analyses and commercial qualities of the coal of the various seams, and finally an attempt to estimate in each case the available coal reserves. The available information concerning the three fields differs considerably, the first named having been quite largely worked and relatively well explored, whilst very little has as yet been done upon the last of the three, although this may well prove to be the most extensive of any. The memoir is illustrated by sketch sections and maps, and constitutes the most complete source of information respecting Natal coalfields which has hitherto been published.

THE Report of the Survey of India for 1923–24 records a considerable increase in the topographical survey of the year, 65,673 square miles being surveyed, an increase of some four thousand square miles compared with the previous year. About 41 per cent of the whole topographical survey has now been completed. Aero-photo surveys were undertaken in the Irawadi delta and in Waziristan. During the year, 187 one-inch topographical sheets were published, and it has now been decided to treat this series as the tactical map of India in place of the half-inch series. One new sheet of the international "one million" map was published, making 13 sheets now available. Of the useful maps of India and adjacent countries on the one-million scale, no new sheets were published during the year. Two new sheets have appeared in the Southern Asia series on a scale of one to two million. The report contains full indexes to all the survey maps.

THE British Museum has recently issued a guide (price 1*s*.) to the collection of fossil plants in Gallery X in the Department of Geology and Palæontology. This guide, which was originally drawn up by Mr. H. Hamshaw Thomas just before the War, has now been revised by Mr. W. N. Edwards, assistant in the Museum, and with its 6 plates, folding-chart of geological strata, and 70 pages of letterpress with 40 text figures, must be regarded as very good value. The guide is simply and concisely written, and concentrates attention mainly upon features which can be seen in plant impressions and without reference to the microscope, though important efforts at reconstruction of long extinct plant types from the scattered material in the rocks are elucidated with the aid of diagrams, some new, some already well known to the student. It may be hoped that this guide will make more accessible, and therefore better known, the palæobotanical resources of the Museum, which include more than 5500 microscope slides from the historic collections of two English investigators, W. C. Williamson and Dr. D. H. Scott.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—Secretary to the Medical Society of London—The Acting Secretary to the Society, 11 Chandos Street, W.1 (September 4). Inspectors under the Ministry of Agriculture and Fisheries for the purposes of the Diseases of Animals Acts, 1894 to 1922—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W.1 (September 7). Two analysts for the building research station of the Department of Scientific and Industrial Research—The Secretary, Department of Scientific and Industrial Research, 16 Old Queen Street, S.W.1 (September 14). A junior assistant physicist at the building research station of the Department of Scientific and Industrial Research—The Secretary, Department of Scientific and Industrial Research, 16 Old Queen Street, S.W.1 (September 14). A preparer in the herbarium of the Royal Botanic Gardens, Kew—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W.1. A pathological laboratory assistant in the Agricultural Department of the Government of Kenya—The Crown Agents for the Colonies, 4 Millbank, S.W.1 (quoting M/13369). A lecturer in entomology, botany, etc., at the Royal Agricultural College, Cirencester—The Secretary.

Research Items

A MAGDALENIAN STATION IN SWITZERLAND.—Dr. Fritz Sarasin and Dr. H. G. Stehlen describe in the *Denkschriften der Schweizerischen Naturforschenden Gesellschaft*, Bd. 61, the results of explorations of a Magdalenian rock shelter at Ettingen near Basel, undertaken in 1918, 1919 and 1922. The latter deals with the animal remains, the former gives an account of the excavations and describes the archæological finds. The uppermost stratum consisted of 1.20 to 1.40 metres of brown earth in which were fragments of human bones, bones of recent animals and potsherds belonging to recent, Roman and neolithic times, but no flint implements. The stratum immediately beneath contained no traces of human occupation, but remains of Magdalenian type were found in the two strata below, the first flint implements occurring in the upper of these two strata at depths of 2.50 to 2.70 metres. The implementiferous deposit continued into the lower stratum, the total depth of the deposit being about 50 cm. at its maximum. The implements found included a number of knives and spear-heads of flint, a doubtful implement of limestone, and an implement made from a long bone, 50 mm. long with a spatulate-shaped end.

THE AGE OF THE PADMA.—Vol. 20, No. 1 of the Journal of the Asiatic Society of Bengal contains an interesting note by Bisvesvar Bhattacharyya on the date at which the waters of the Ganges which it is known originally flowed to the sea through the channel now indicated by the Bhāgirathi, the Hoogly and the Tolly's nulla, were diverted eastward into what is now the Padma. It is usually assumed that this was caused by a diversion in the course of some northern rivers which took place about the sixteenth century. References in Bengal literature, however, support an earlier date. Thus a copper plate inscription of Srichandra Deva from South Faridpur recording a grant of land shows that in the tenth-eleventh centuries the Padma flowed through that district but not as a considerable stream, while from a poem by Dhoyi, who flourished in the twelfth century, it may be inferred that the Bhāghirati was then a mighty river. In a poem believed to be of the fifteenth century—the *Rāmāyana* of Krttivasa—there is a legend recording that a sacred goddess was taken away through the Padma and brought back through the Bhāgirati, which may be a traditional reference to the diversion of the waters of the sacred stream. The Vaisnava literature shows that by the end of the fifteenth century the position of the Bhāgirati as an important river had gone. It would appear, therefore, that the diversion of the waters to the Padma must have taken place in the fourteenth if not in the thirteenth century.

GROWTH AND SPAWNING OF SALMON.—Mr. W. L. Calderwood has given data on the growth of the salmon (Proc. R. Soc., Edin., vol. 45, No. 13, 1925). He emphasises the great amount of growth which takes place during the first summer of sea-feeding, often continued during the second summer in the sea. Two years commonly elapse before the first seaward migration of the smolt, and such a fish, after spending a year and a varying number of months in the sea, has grown to about three times what its length was when a smolt, and now as a grilse it returns to the river. Other fish have spent two or three years in the sea; these, with two years of early life in the river, are therefore five years old, and still others have spent a further year in the sea and, not having lost weight by leaving their feeding grounds and spawning, they are of great size. Mr. Calderwood states that all fish more than 50 lb. weight are males, and that during his twenty-five years' experience of Scottish salmon fisheries, he has known only two cases of females more than 40 lb. in weight, and both fish came from the river Lochy; one weighed 43 lb. and the other 48 lb. He asks why it is that the salmon which enter the streams of outlying islands, *e.g.* Lewis, Mull, Skye, and those of small and rocky catchment areas on the mainland are always small, and suggests that it is because of the poor river-feeding for the parr and smolts in those barren grounds. Another feature of the salmon of these small Highland streams is that they return to spawn more frequently than do the fish of the larger rivers. In the river Add in Argyll, fish have been found with three and four spawning marks, and one kelt showed four spawning marks and therefore had spawned five times, which appears to be a unique case. Of all the salmon scales examined by various investigators only eight which show four spawning marks are recorded—two from the St. Lawrence, four from the Add, one from the Conon, and one from Loch Maree.

CLYDE PLANKTON.—Miss S. M. Marshall has studied the plankton of the Clyde for the years 1923 and 1924, and has summarised the principal results (Proc. R. Soc., Edin., vol. 45, No. 12, 1925). The general course of events was the same in both years and is similar to that found at other stations. There is a winter minimum followed in early spring by a large increase in the number of diatoms and of larval forms, *e.g.* of copepods, cirripedes and molluscs. This is followed in May and June by a period poor in diatoms but rich in crustacea. July, August, and September are the months richest in variety—diatoms are abundant, peridinians reach their maximum, larvæ of all kinds are numerous, as are also medusæ and sagitta. The autumnal diatom maximum is in August or September, after which the number and variety of planktonic organisms decrease. The first part of the paper deals with the organisms in systematic sequence, noting their relative abundance at various seasons, while the second part is a summary of the plankton month by month in 1923.

THE SANTA BARBARA EARTHQUAKE.—A short article on the Santa Barbara earthquake by Dr. Bailey Willis, the well-known student of Californian earthquakes, is published in *Science* for July 10. Dr. Willis was in Santa Barbara when the earthquake occurred, and states that it was a moderately severe, but not a very severe, earthquake. That it was much slighter than the Montana earthquake which occurred thirty-six hours earlier is clear from the fact that it was felt in only four counties in California, while the Montana earthquake disturbed four States. The Santa Barbara earthquake, Dr. Willis considers, was due to a movement of a fault that runs along the Santa Inez range of mountains, the movement being from south to north. As each of the four great faults of southern California has produced an earthquake during the last seven years, and as the last great earthquake of the Santa Barbara region occurred in 1857, an earthquake there was expected by American seismologists, and the prevailing feeling seems to be one of relief that it was not more serious. It was known that a strong pressure is being exerted against the Santa Inez range from the south, as Gaviota Peak, a triangulation point of the U.S. Coast and Geodetic Survey, has been thrust 24 feet northward in thirty years.

RIVER GAUGING.—A pamphlet entitled "River Gauging" has recently been issued by the Department of Scientific and Industrial Research, being a Report by Dr. M. A. Hogan on methods and appliances for use in Great Britain (London: H.M. Stationery Office, 1925, 2*s*. 6*d*. net). As a review of the present state of knowledge on a complex and difficult operation, the publication is an exceedingly interest-

ing and serviceable compilation It was prepared for the Committee on Gauging of Rivers and Tidal Currents, and the conclusions arrived at are endorsed by them and embodied in their report Very briefly, the general conclusion is that methods and instruments for gauging are available and adequate for the needs of a hydrometric survey In detail, for gauging small streams some form of measuring weir is suggested with an automatic recorder For large streams with natural flow, the discharge can be expressed as a function of the water level provided the bed of the river does not alter its character the curve representing this function in any given case can be drawn from measurements of the discharge by a current meter—this is known as the 'stage-discharge' curve For large streams artificially regulated, the stage-discharge method is useless, but measurements can be made by calibrating a weir by a combination of model experiments and current meter measurements The most generally useful type of meter on the market is stated to be the small Price meter, as used in the United States This meter has proved reliable and convenient where the velocity of flow is not less than half a foot per second and there is no undue turbulence 'Where turbulence exists' it is advisable to take readings both by the Price and screw type meters 'Under turbulent conditions" a propeller meter with a guard ring such as the Stoppani should be used, as this type is subject only to small error when measuring oblique velocities

ATMOSPHERIC POLLUTION —The tenth report of the Advisory Committee on Atmospheric Pollution which has recently been issued by the Meteorological Office, Air Ministry, shows continued activity on the part of this body during the financial year 1923–24 The report is divided into eight sections three of which deal with methods of measurement of atmospheric pollution which have now become well established These are (1) the standard collecting gauge which measures the impurities brought down by rain (2) the automatic filter which gives a semi-continuous record of the amount of impurity in the air, and (3) the dust counter The remaining five sections are devoted to more recent developments of the work Of these, the research into the effect of atmospheric pollution upon visibility is drawing to a close A close connexion has been found between the amount of impurity as measured either by the automatic filter or by the dust counter and the percentage transmission of light through 50 feet of air It is probable that the relationship would be even closer were it not for the presence of small water drops in the air in foggy weather These drops affect the visibility but not the pollution measurements, and no satisfactory means of measuring their number has yet been found Some useful measurements of dust in the upper atmosphere taken on aeroplanes are recorded from America, but it has not yet been found possible to obtain records in Great Britain, though it is hoped the difficulties in the way may be surmounted shortly In two other sections a new dust counter for use in exceptionally dusty atmospheres is described, and the darkness of January 23, 1924, in London when a high fog of unusual intensity prevailed, is discussed in some detail It is noted that records from one or two additional standard collecting gauges are still needed in country districts, though urban areas are well represented It may be hoped that this need will soon be met

WEATHER AT FALMOUTH —Meteorological notes and tables for the year 1924 prepared by Mr J B Phillips, superintendent of the Falmouth Observatory, have just been issued Many features of general interest have been brought out in the notes by the author Temperature comparisons are made with other stations reporting to the Air Ministry which show Falmouth to enjoy a generally mild winter The mean air temperature for the year was 51° 2 F, which is 0° 5 warmer than the normal for 50 years the coldest month was February with a mean 41° 5 the warmest, July with 59° 5 The absolutely highest temperature was 69° in August, and the lowest 27° in February The duration of bright sunshine in 1924 was 1597 hours which is 156 hours less than the normal for 40 years the brightest month was July with 208 hours, and the months with least sunshine were January and December with 59 and 60 hours respectively There was a great preponderance of winds from south and west, these directions occurring on 238 days while north and east winds blew only on 128 days The total rainfall for the year was 58 08 inches

CINEMATOGRAPHY IN COLOURS —The Keller-Dorian method of cinematography in colours is described by M A Troller in *La Nature* of August 1 A colour filter is inserted between the components of the lens, which is divided into two equal segments with a parallel-sided strip between them, each of the three spaces thus provided being coloured with one of the three primary colours The film has impressed upon the back of it closely packed lens-like projections, at the rate of about thirty to forty to the mm , and this side is turned towards the lens so that each of the lenticular projections on the film gives a minute image of the tricoloured filter on the sensitive surface For projection the arrangement is the same, but the direction of the light is reversed To produce the projections on the back of the film, a skilled engraver working under a microscope cuts an original, and from this a suitable steel roller is prepared, which is mounted with an ebonite roller so that the film may be passed between them The steel roller is electrically heated to 100° C to soften the base of the film, and enable it to take the impression

XENON HYDRATE —A hydrate of argon was discovered by P Villard in 1896, and M R de Forcrand announces in *C R Acad Sci*, Paris, July 6, that he has prepared xenon hydrate by compressing the gas, with a trace of water, in a Cailletet apparatus He had already found a crystalline hydrate of krypton, with the probable formula $Kr + 5H_2O$ in 1923, but the xenon hydrate is produced much more easily only a few atmospheres being required to coat the walls of the tube with a kind of hoar frost without the application of ice At temperatures in the neighbourhood of 0° C, this remains intact when the pressure is only a little above that of the atmosphere A table gives the heat of formation starting with liquid water, at a series of temperatures and pressures ranging from 1 4° C and 1 45 atm up to 23 5° and 17 00 atm, the mean value being 18 266 At and above 24° C the hydrate is not formed even with very high pressure, the corresponding temperature for krypton is 13° It is found graphically that the dissociation pressure of one atmosphere corresponds to a temperature of − 0 13° The calculated number of molecules of water to one atom of xenon is 6 6, that is to say, that there are 6 or 7 molecules of water in the hydrate The dissociation pressures at 0° C are 1 15 atm for xenon, 14 5 for krypton, and 98 5 for argon, a hydrate of neon has not been obtained even with 260 atm at 0° C Thus the stability of the hydrate increases with the molecular weight of the gas and this is also shown by the heats of formation of the hydrates

Carnot's Cycle and Efficiency of Heat-Engines[1]

CARNOT laid down the great and incontrovertible principle that if, when we have obtained motive power by the application of heat, we inquire whether we have obtained the maximum of motive power from this application, we can answer this question by ascertaining whether by applying the same amount of motive power in reversing the process of expansion, or expansion and contraction, in the course of which we have obtained motive power, we can bring the working substance back to its starting point. When the process is reversible in this manner we have obtained the maximum possible output in motive power, whatever be the nature of the working substance, gaseous, liquid, or solid.

Carnot thus furnished a criterion by applying which we could judge of the efficiency of a heat-engine. Unfortunately, however, he failed in applying that criterion correctly. His unsuccessful attempt was, however, a great one, since it has continued to mislead scientific men, and confuse engineers for now more than a century. Carnot invented the famous Carnot cycle, the bugbear of generations of students, and with it an argument to the effect that it is the most efficient cycle possible in the mode of action of a heat-engine.

It is evident that in the cycle described by Carnot much of the heat taken up from the source in the second stage (isothermal expansion) is thrown away into the condenser in the fourth stage (isothermal compression). This is apparently a waste of heat energy. It is only in the second and third stages of the cycle (namely, isothermal expansion and adiabatic expansion) that work is done on the engine, or motive power is, to quote Carnot's expression, gained. It is, therefore, at the end of stage three that we must apply Carnot's test. When we do so, and simply re-compress the air to its starting volume, we find that much more work has to be done on the air than was done by it during the second and third stages of the cycle. We have, therefore, in stages two and three of the Carnot cycle expended heat which could have been converted more completely into mechanical energy if we had employed adiabatic expansion; and this waste has evidently occurred in the isothermal stage of expansion, since the third stage is in each case adiabatic.

We thus see that the Carnot cycle is radically inefficient. A great deal of heat is transferred quite uselessly from the source to the condenser, and thus wasted. To obtain from the heat communicated to the air in the cylinder the maximum of work on the engine during the expansion we must quite evidently make the whole expansion adiabatic, while to reduce to a minimum the corresponding work done by the engine in the compression stage, we must make the whole of the compression isothermal, thus throwing away as much heat as we can with the condenser at its existing temperature.

It is evident that by eliminating altogether the effects of atmospheric pressure, we could at once obtain fifty per cent. efficiency in the cycle of an ideal heat-engine. This is accomplished in the ideal cycle of a steam-engine working with complete adiabatic expansion of the steam down to the pressure of the aqueous vapour in the condenser. In this case the cylinder would be enclosed above, and would contain at the start nothing but aqueous vapour at the pressure corresponding to atmospheric temperature, except for a little water in the space below the piston. In stage 1 the water would be evaporated before the piston was allowed to move. In stage 2 the steam would expand adiabatically, doing work on the engine, until it reached the pressure of the aqueous vapour above the piston. In stage 3 the piston would return to its original position without any net work being done by or on the engine and the steam not already condensed would condense again to water. Half the heat applied would be spent almost entirely on the engine during expansion, and the other half would pass into the condenser as the piston returned. The efficiency would thus be practically fifty per cent.

We can see now that the percentage efficiency of a heat-engine, or at any rate of a steam-engine, provided that the expansion is adiabatic and complete, and the compression isothermal, does not depend at all on the difference between the initial and final temperature during the expansion. We can quite evidently obtain just the same percentage efficiency with a small as with a great difference of temperature. On this point we are running counter to cherished academic doctrines and to authority which has been generally accepted for more than seventy years; but that authority rests upon the quite mistaken conclusion that the Carnot cycle is one of maximum efficiency within a given interval of temperature.

Let us now look more carefully and at the same time from a wider point of view, at the reason why more than fifty per cent. efficiency is impossible in a heat-engine. In the case of the air-engine starting from atmospheric pressure and temperature, it is the atmospheric pressure which limits the stage of expansion. The air can no longer expand and do external work after its pressure has fallen to that of the atmosphere pressing on the upper side of the piston. Now the pressure of the expanding air falls in accordance with Boyle's law in proportion to its relative increase of volume; but the work done during adiabatic expansion, and consequently the fall in absolute temperature of the expanding gas, depends also on the pressure, and therefore proceeds also in proportion to the relative increase in volume. The air in the cylinder can only exist in the expanded state at the existing pressure in virtue of an increase of absolute temperature proportional to the increased volume. This follows from Charles's law. Hence, assuming Charles's law, for every degree of temperature lost by the air in expansion, the air in the cylinder must be a corresponding degree above the atmospheric temperature which it had before heat was applied to it. When the temperature of the expanding gas has fallen by half the amount to which it had been raised, this condition is no longer possible, and the air can no longer expand against the atmospheric pressure. Half the heat has gone in external work, and half remains in the expanded air, and must be thrown away if the air is to be brought back to its original state with the help of atmospheric pressure alone.

The conception of the Carnot cycle, with its extraordinary peculiarities, was quite evidently based, not on the study of actual heat-engines, but on Carnot's ideas, derived from the caloric theory, of how a heat-engine works. These ideas led him to the conclusion that in the working of a heat-engine any change of temperature in the working substance, unless the change is accompanied by change in volume, is a waste of heat. Hence the strange feature of the Carnot cycle that in it there is no change of temperature without change of volume.

As we have already seen, the whole of the expansion and none of the compression must be adiabatic

[1] Abstract of a paper on "The Maximum Efficiency of Heat Engines and the Future of Coal and Steam as Motive Agents," read before the Institution of Mining Engineers on June 16 by Dr. J. S. Haldane, F.R.S.

in a heat-engine working with maximum efficiency There must also be one and only one stage in which abrupt change of temperature occurs without change of volume In the steam-engine with maximum expansion of the steam, there is abrupt rise of temperature at the beginning of the cycle If, as in the Watt-Newcomen engine, there is also abrupt fall of temperature before expansion is complete, loss of efficiency is a necessary result

At the present time steam-engines and oil-engines are running a neck-to-neck race as regards many employments, while elsewhere the oil-engine is everywhere being applied for quite new purposes where no heat-engine had previously been applied In the opinion of many persons the steam-engine is bound to be displaced more and more by the internal-combustion engine This opinion is largely based on the current academic doctrine that the efficiency of a heat-engine depends on the absolute temperature reached in the engine In the present paper the academic teaching has been thrown to the winds, backed though it be by the names of men to whom the whole world has good reason to be grateful A step further may also now be taken We suggest that the development of the steam-engine has been very greatly hindered by the fallacious teaching associated with Carnot s cycle Engineers have been prevented from seeing clearly what the maximum efficiency of a heat-engine is, where that efficiency is being needlessly lost, and how the steam-engine can be modified to suit varying circumstances without loss or with minimum loss, in efficiency

We still use furnaces and boilers which waste much heat whenever an engine is temporarily out of action or doing only light duty even though they may be so designed as to cause very little waste, during continuous full duty of the engine It seems probable that the furnaces and boilers of the future will be gas fed, the gas being formed in a heat-insulated producer or carburettor, and only made and burnt as the steam is required the whole regulation being mechanical and the heat of the waste gases being nearly all returned to the furnace and boiler Another alternative presenting similar advantages is the use of pulverised fuel The boiler and furnace can then be made much smaller than is now usually the case

As regards modifications of the steam-engine to suit varying circumstances, it seems that small engines, working at very high pressures, and with correspondingly small tubular boilers, will come more and more into use A steam pressure of 100 atmospheres, with a corresponding temperature of 600° F, seems well within reach At such a pressure the percentage loss of efficiency, owing to either the discarding of a condenser or condensation at or even somewhat above boiling-point, would not be too large The bulky apparatus required for complete expansion can thus be dispensed with, reducing the engine to extremely compact proportions and very small weight By these means the steam-engine can be rendered far more compact and adaptable to varying conditions under which only internal-combustion engines, or steam-engines without a condenser, are now used

Perhaps too sanguine a view is taken of the future of the steam-engine, but it seems that in every case where either fuel economy or size of engine is of predominating importance, the steam-engine and coal will in the future displace the internal-combustion engine and oil Even where oil or gas is alone desirable or available as fuel, it will probably turn out to be cheaper where fuel economy and weight of engine are important, to use them as fuels for steam-engines The latter will probably take the place of internal-combustion engines in even motor vehicles and aeroplanes With the further development of electrical transmission of power obtained from coal and steam, the steam-engine and coal will also come more and more to the fore

The Motion of Whales during Swimming

By Dr C G JOH PETERSEN, Director of the Danish Biological Station, Copenhagen

IN our two well-known Danish zoological handbooks it is stated regarding the swimming of whales, in one that "It is the screwing actions of the hind part of the body (the tail) which force the whale through the water, the tail fin acting only to balance up and down," in the other that "The whales move in the manner of fish by flapping the tail from side to side", according to a verbal statement this was observed by the author himself on porpoises in a tank in the Zoological Garden In the foreign literature I have found information[1] that whales when swimming rapidly, move the tail fin up and down, when they swim slowly, on the other hand they perform screw-like motions Porpoises have been observed in tanks in England to swim by moving the tail fin up and down with slight undulations to each side

Thus there seem to be greatly divergent opinions as to the manner in which whales effect their swimming movements I have myself seen dolphins following *e g*, the steamship of the Biological Station, and I have spoken with many others who have seen the same, we are agreed that it is impossible to see how they swim, they only tremble, but follow, apparently with ease, the largest steamship going at full speed

In the spring of 1924 I was by chance present at a catch of porpoises in the Bramsnæs Vig (by Holbæk), and there I bought the tail of a porpoise just caught Dr Blegvad, the assistant of the station, and I dissected it, Fig 1 is a sketch of the result At the base the tail fin is very flexible, so long as it is in a fresh condition, similar to the carpus of the hand of man The vertebræ here are very flexible in relation to each other, and the vertebral column extends right out to the posterior edge of the fin No muscles are found in the tail fin itself, only four strong tendons extending right out to the extreme vertebræ these tendons may move the horizontal fin up and down, but scarcely with any force, and doubtfully sideways The flukes of the tail fin consist only of epidermis and fibrous tissue they are somewhat elastic for movements up and down Of other muscles in the tail (hind part of the body) there are two for lateral motions and two for vertical motions, they terminate with strong tendons some distance from the root of the tail fin

The tail fin with its vertebræ may thus be moved up and down by bending at the root, but these movements do not seem to produce force enough for powerful swimming, because, amongst other reasons, the flukes will impede the speed considerably when in their extreme positions One can well imagine that quick movements of the flukes towards the horizontal position may give a small speed, as when a rudder is moved in a little boat, this produces a slight speed, if the motions towards the central

[1] Beddard, 'A Book of Whales, London, 1900 Murie 'On the Anatomy of a Fin Whale,' Proc Zool Soc 1865, T Bell Pettigrew, 'Animal Locomotion, London, third edition, 1883

position are the strongest. But if we imagine that the extreme part of the tail (the hind part of the body) itself is moved up and down, even if these movements are only slight, the elastic fin would be enabled to take up suitable inclined positions for up-and-down movements and thus give effective power during the full extent of the motion (Fig. 2).

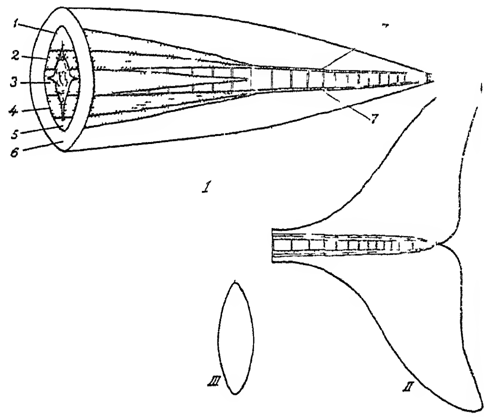

FIG. 1.—Combination of a vertical transverse section and a vertical longitudinal section through the tail of the porpoise. 1 Dorsal muscle; 2 the two upper tail fin muscles; 3 the two lateral muscles; 4 the two lower tail fin muscles; 5 ventral muscle; 6 layer of blubber; 7 left upper and lower tail fin tendon. II The tail fin seen from above with its two upper tendons and the vertebræ denuded. III Transverse section through the tail.

In order to try this, I had a thin steel plate made, shaped like the tail fin of a porpoise, and attached it to a vertical stick; when this stick was moved up and down in the water at a suitable speed (rhythm) the plate produced a powerful current rearward, simultaneously forcing the stick forward, against the edge by which I supported it. The steel plate I employed was too thin and flexible for a continuation of these experiments, for I could only "swim slowly" with it, and to procure a stronger one took so long, that I was not able to proceed further; but the experiment had proved, without doubt, that by means of small movements up and down of the terminal part of the tail, the tail fin of the dolphin may be employed as an excellent means of propulsion, inasmuch as its muscles (tendons) may give it the correct rigidness, corresponding with the varying speed through the water; in this the operations of the four named muscles and tendons surely may be sought. When the dolphin starts swimming, large movements are required to move a sufficiently large quantity of water; but when speed is once gained, the water will be felt hard, and then only small but quick motions up and down, with more force and more rigidity in the tail for each stroke, are required. Dolphins are said to be able to follow destroyers up to a rate of about 30 knots, *i.e.* at the same speed as fast trains go between Copenhagen and Korsør.

It is the great drawback in all steamship propellers that their mould cannot conform with the variation in speed, and that they are quite without elasticity; they yield, therefore, only a comparatively small effective power. Mr. Vogt, an engineer, has endeavoured with the pendulum propeller to produce a variable pitch by means of a complicated system of springs (metal springs), and he really succeeded in this; but the construction seems to have been too expensive to make use of practically.

By means of the elastic and flexible structures of which the tail fin and the tail of the porpoise are made it is, on the other hand, possible to obtain an enormous effective power by comparatively few and small movements; thus there is no need for astonishment that this little fin is really able to give such a high speed to the big animal. Mr. Vogt, with whom I have debated this matter, agreed fully with me on this point, as well as, on the whole, with my views upon this matter.

The objection may be raised to this illustration of the swimming movements of the whale, that the movements up and down of the tail itself must evidently impede the speed through the water; but the tail of the whale is, as a rule, so compressed in the terminal part that the resistance offered is considerably diminished, and, furthermore, it refers only to small, vertical movements.

As is well known, many fishes swim by performing lateral movements with the tail, because the fin is set vertically, *i.e.* on the same principle as the motions of whales, which only move the fin up and down because this is situated horizontally; that fish in addition to these movements may also perform screw-like motions, is also well known from seeing goldfishes in aquaria. But they do this only when swimming slowly; if speed is desired, it is gained by means of strokes from side to side, analogous to the up-and-down strokes of the whales.

It is now easily understood why many people, including myself, who have observed dolphins following steamships during speed, have seen nothing but a trembling of their bodies, because the movements of the tail and the fin are up and down and comparatively slight and vertical movements are not easily observed from above. Had there been sideways or screw-like motions they could not have escaped the observer; that such movements also may be performed by whales, I do not doubt, but they occur only during quite slow movement, when the whale feeds, or when for some other reason it is in no hurry.

When, especially from observations of porpoises in tanks, lateral motions of the tail are mentioned, or

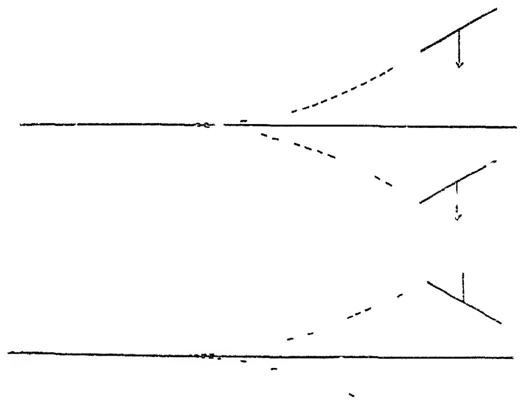

FIG. 2.—The positions of the tail fin (IV.) during downward movement of the tail, (V.) during upward movement of the tail.

that the tail is used in a fish-like manner by strokes from side to side, this evidently arises from the fact that here the animal the whole time had to steer in order to avoid running against the sides of the tank. The observations themselves undoubtedly are correct. But statements to the effect that the tail fin is exclusively used for steering up or down are false; it may be used for this, and certainly also for steering sideways, but the flukes of the tail fin are the proper

organs for propulsion of the whale, as the propellers are in a ship, and the importance of the tail (hind part of the body) corresponds to that of the ship's engine which moves the propeller

If we compare the size of the propeller of a steamship with the size of the ship, the propeller seems small, and still it may, in spite of its slight effective power propel the ship, the tail fin of a dolphin or a whale is not smaller in comparison with the size of these animals than the propeller of the steamship but larger if anything Thus, bearing in mind the obviously far greater effective power of the fins of the whales it is not to be wondered at that these animals may follow the biggest steamships with ease and even follow our quick destroyers in fact a harpooned whale may carry away a steamship with great velocity through the water in spite of the steamer backing full speed with its propeller

I have presumed that the anatomy of the tail and the tail fin is mainly the same in the porpoise as in the other whales this however as well as so many other things concerning this matter I must leave to others who may get an opportunity to examine it more closely

Physics in Radiology

SEVERAL notable papers were read before the Physics Section of the International Congress of Radiology, which was held at the Central Hall, Westminster on June 30-July 4 The work of the Congress began with a joint discussion in which the Physics and Radiology Sections met for a full day's consideration of the difficult problem of X-ray measurement This discussion was opened at 10 A M on July 1 before a large attendance by Sir William Bragg and Dr Beclere the president (Dr T Holland) occupying the chair The importance of such a discussion, in which representative men from practically all over the world took part, is obvious, and it is satisfactory to be able to report that the practical outcome has been a definite proposal as to the mode of initiating the formation of an International Committee to deal with the matter

Sir William Bragg dealt generally with the importance of physical measurements and referred to the difficulties already met with in determining the brightness of light He pointed out that the X-ray problem has special added difficulties of its own First comes the question of a unit, and then the production of standards to be expressed in terms of the agreed unit and finally it remains to ascertain what biological effects are associated with certain rays, or groups of rays, so measured He was hopeful that a successful issue will ultimately result from the efforts now being made throughout the world towards setting up a suitable system of X-ray measurement, but he warned his hearers that the question of an X-ray unit is beset with more difficulties than have ever been met with in the case of any other unit which science has been called upon to devise Finally, he directed attention to the principles which must underlie such a system and set the problem clearly before the meeting

Dr Beclere, of Paris, spoke more in detail with reference to the conditions which the medical radiologist has to face, referring to the pioneer work of Villard, and discussing the actual methods of measurement suggested by Solomon, Kionig and Friederich, Seit and Wintz, and others He made an eloquent appeal for international unity in regard to the question of X-ray measurement

On the conclusion of the formal opening of the discussion, the chairman of the Physics Section (Major C E S Phillips) presided for the rest of the day In the course of his remarks, Dr Beclere strongly urged the setting up of an International Committee to deal with X-ray measurements and Dr Finzi who spoke later also directed attention to the matter and seconded Dr Beclere's proposal, which on being put to the meeting was carried with enthusiasm

Dr Beclere was followed by Dr Solomon (France), Dr Behnken (Germany), Prof Grebe (Germany), Dr Altschul (Czechoslovakia) Dr Shaxby (Cardiff) who read a communication from Dr A Dauvillier (France) Dr Finzi (London) Dr Moore (London) Prof Wintz (Germany) Dr Reyjeski (on behalf of Prof Dessauer) Dr Glasser (U S A) Prof Friederich (Germany) Dr Mallet (France) Dr Holdfelder (Germany) Prof Holthusen Dr Coliez Prof Crowther (Reading) Prof Russ (London) and Dr Ernst (U S A) The chairman directed attention, at the conclusion of the discussion to the principal points raised, and emphasised the desirability of taking steps towards the establishment of an International Committee to pursue the subject

On Wednesday evening the Silvanus Thompson Memorial Lecture (inaugurated by the Rontgen Society) was delivered (in English) by the Duc de Broglie and attracted an enthusiastic audience The nature of the secondary radiations set up by X- and gamma rays and attempts to understand the process by which they are initiated, are matters of great importance and interest to radiologists generally, and especially to those searching for clues as to a biophysical explanation of the effects of radiations upon tissues The Duc de Broglie eloquently summarised our present knowledge of this subject and gave a valuable account of some recent researches by French physicists who have been extending the work begun by Rutherford, C T R Wilson, Ellis and others relating to the problem At the conclusion of the lecture the Silvanus Thompson Memorial Medal was handed to the Duc de Broglie by the president

On Thursday morning an interesting paper on the radiography of coal was read by Mr Norman Kemp, and Dr Bouers then described a new metal X-ray tube (Metalix) for use in radiography and X-ray therapy This was followed by an important paper by Prof Friederich (Freiburg) in which some new results were described The last paper of the morning was read by Dr Koopman of Amsterdam who showed a novel type of Potter-Bucky diaphragm The variety and originality of these papers were striking, and interesting discussions followed each one of them

In the afternoon the Section did not meet, on account of the visit to the National Physical Laboratory, which had been arranged for that day in response to the kind invitation of the Director

The Section again met on Friday morning at 10 A M for a discussion of methods of protection, opened by Dr G W C Kaye, of the National Physical Laboratory An animated debate followed, to which M Pilon (Paris) sent a written contribution (read by Mr Gough) and the following took part Dr Ferreaux (Paris), Mr Pullin (London), Dr Pirie (Montreal), Dr Shaxby (Cardiff), and Dr Moore (London) Dr Kaye, in his reply directed attention to the need of standardising the scheme of protection, and proposed the following resolution, which was seconded by Mr Pullin and unanimously agreed to

"That the Physics Section of the first International

Congress of Radiology wishes to place on record the desirability of adopting a standard scheme of X-ray and radium protection throughout the world "

The morning session was brought to a close with a valuable paper by Prof F L Hopwood, who dealt in detail with the organisation of a hospital radium service Considerable discussion ensued, in which Dr Ferreaux, of the Radium Institute, Paris, and Dr Failla, of the Memorial Hospital, New York, took part

The afternoon session was opened with a paper (read in title only) by Dr George Clark (U S A), which was followed by an interesting contribution by Dr Lewis Simons (London) entitled " The Basis of the Selective Chemical Action of X-rays and Light," and the work of the Section was brought to a close by a discussion dealing with modes of producing currents at constant high potential This discussion was opened by the chairman (Maj C E S Phillips) who gave a general survey of the subject Many speakers stated their views, and Prof Dessauer described his new methods now in use in Germany Dr Moore, Mr Gunstone, and others contributed to the discussion in which all were agreed as to the desirability of adopting constant high-tension apparatus for accurate physical or therapeutic work

It is clear from the work of the Congress that physics is playing an important part in the progress of medical radiology, and that the scope of its usefulness is ever widening The study of X-ray spectroscopy, for example (to mention only one aspect of it), has already lead to the design of wave-length measuring instruments for use in the ordinary routine work of a medical X-ray department, as well as furnishing a knowledge of organic structures unobtainable by other means A well-organised exhibition of apparatus held in conjunction with the Congress also testified to the many practical applications that have arisen from work in radiation physics, which has been carried out in many parts of the world during recent years, as well as to the ingenuity of those who provide appliances for medical radiologists

The truly international character of the Congress was very striking There were representatives from India and Iceland, from Sweden, Russia, Czechoslovakia, France, Belgium Germany, Italy, U S A , Canada, and so forth , and it was a remarkable fact that this great medical meeting had been made possible by the researches of a physicist whose rare distinction it was to have given to the world a discovery of such far-reaching possibilities for the good of mankind It was generally acknowledged that the Congress had proved a success , it had in fact, brought together representative men from many parts of the world, whose enthusiasm was tempered only by a desire to advance cautiously in a field of medical work which is admittedly still imperfectly understood

C E S PHILLIPS

Industrial Water Supply

THE subject of industrial water supply and stream pollution was discussed at the joint meeting of the Institution of Chemical Engineers and the American Institute of Chemical Engineers, which was held on July 17, in Leeds Messrs F P Veitch and L C Benedict of the Bureau of Chemistry (U S A), contributed a valuable paper on the composition and disposal of wool-scouring waste liquors in which they described current methods of recovering wool-grease and fertilising material from them, as well as recent work done by the Bureau which indicates the superior advantages of extracting with naphtha and subsequent scouring with soap and water They estimate that the wool-scouring liquors annually produced in the United States contain, in millions of pounds weight grease 60-70, potash salts 40-48 nitrogenous matter 15, and dirt 60-90 the total value of which is about 5 million dollars The authors are convinced that wholesale economic recovery of the valuable ingredients is possible

Mr W L Stevenson, chief engineer to the Department of Health Commonwealth of Pennsylvania, criticised most legislative efforts to control pollution of streams as being too peremptory and too punitive, and he advocated the policy of scientific and friendly co-operation between municipality and manufacturer, such a policy is successfully pursued by the Sanitary Water Board of Pennsylvania which, *inter alia* has re-classified the waters of that State on the principles of conservation and controlled utilisation The nature of the restrictive and penalising legislation passed by most States was well shown by Mr E B Besselievre, of New York, whose paper included a summary of the rules upon which the decisions of courts of justice have been based Mr H C Parker, of Pennsylvania, described recent developments and improvements in the apparatus used for determining hydrogen-ion concentration in industrial effluents and sewage liquors

Of the papers presented by British workers that by Dr T Lewis Bailey, of the Ministry of Health on effluents from ammonia plants of coke-oven and gas-works, was of outstanding importance Such effluents, it is well known, are the source of much trouble at sewage-disposal works, and Dr Bailey has for years past been investigating methods of prevention and cure He described the probable origins of, and the possible ways of eliminating, the harmful ingredients (chiefly ammonium thiocyanate, ammonium thiosulphate, phenol, organic bases and higher tar-acids), but holding that prevention is better than cure, he indicated how relatively clean ammoniacal liquors can be produced by minimising the time of contact between tar and liquor, and by rapidly cooling the crude gas in water-cooled systems, together with rigid exclusion of " adventitious " air Bad effluents from ammonia plants can be successfully purified in percolating filters, given proper dilution and adequate regulation although this method is seldom practicable at gas-works owing to lack of the necessary ground space

Mr R D Littlefield, also of the Ministry of Health, retold the interesting tale of how the Royal Commission on Sewage Disposal solved the problem of purifying the effluents from Scottish distilleries Here again the percolating filter did what was required, after suitable inoculation

Water-softening by the base-exchange method was the subject of two contributions Dr E B Higgins and Mr J P O Callaghan summarised the advantages which this method has over the older lime-soda process and described in outline the preparation of ' Permutit," both the artificial material (made from sodium silicate and sodium aluminate) and the natural material, which is prepared from greensand or glauconite In their opinion, natural zeolite is the better owing to its rapidity of action and of regeneration with sodium chloride solution, as well as on account of its superior mechanical and chemical stability On the other hand, Dr T P Hilditch and Mr H J Wheaton claimed that the water-softener " Doucil " is practically free from the defects which the previous authors held to be inherent in all such artificial base exchange materials

Societies and Academies

EDINBURGH

Royal Society, July 6.—G. Leslie **Purser**: *Calamoichthys calabaricus* Smith. Pt. 1. The alimentary and respiratory systems. Calamoichthys is the less known of the two genera of the Polypterini. The histology of the alimentary tract is not so complex as the anatomy would lead one to expect, as the intestinal epithelium is practically the same throughout its length; and as a whole the digestive tract is of a simple piscine type. Gills are well developed, but in addition there is, opening into the pharynx by a median ventral glottis, a pair of lungs, the minute structure and the vascular connexions of which show how well the pulmonary respiratory mechanism is developed.—W. W. **Taylor**: The precipitation of sols by polyvalent ions. With the alkali salts of methanetrisulphonic acid and naphthalenetrisulphonic acid, which are neutral, there is only one zone of precipitation of ferric hydroxide sol, which commences abruptly at about 0.0002 N and extends up to the saturated solution. It is not followed by a zone of no-precipitation. The range investigated was from 7×10^{-8} N to nearly 1.5 N. They thus fall in line with the neutral chloride and sulphate solutions. The two zones of precipitation, separated by a zone of no-precipitation ("reversal") obtained with sodium phosphate, which contains OH' and no trivalent anion, is ascribed to the OH'. If this be the case, the analogous behaviour of negative sols with ferric and aluminium salts will be due to their hydrolysis. Whether the presence of a polyvalent ion is also necessary is not certain. With the neutral anions more or less periodic variations in the rate of precipitation were observed; these are not due to errors in procedure. The valency rule does not hold in the case of the above trivalent anions.—E. **Neaverson**: Ammonites from the Upper Kimmeridge Clay. The Upper Kimmeridge Clay includes a variable series of clays and sands lying between the Gravesia zones of the Lower Kimmeridgian and the base of the Portland Stone Series. The zonal sequence is here tabulated with equivalent stratigraphical terms:

5	pallasioides zone	Hartwell Clay
4	rotundum zone	
3	pectinatus zone	Swindon Sands, Oil Shale of Kimmeridge
2	nodiferous zone	Kimmeridge Clay (in part)
1	Wheatleyensis zone	

The ammonites have hitherto been grouped under the name *Ammonites biplex*, which, as Lamplugh pointed out thirty years ago, is useless for stratigraphical purposes. Though the forms found in the Hartwell Clay are familiar (but undescribed), those in the lower two zones are practically unknown in literature, and none has previously been described or figured. Some of these ammonites have been recognised in the Upper Kimmeridge Clay (*sensu anglico*) of Boulogne, but their identity with Russian forms (suggested by Pavlov and others) is not accepted. Indeed, palæogeographical considerations seem to indicate that the British and Russian areas were not in direct communication during the period when these ammonites flourished.—Prof. A. A. **Lawson**: A contribution to the life-history of Bowenia.—J. E. **Nichols**: Meteorological factors affecting fertility in sheep. The association of climatic conditions at times of service and lambing in a Cheviot and a Blackface flock, kept under the same conditions of pasturage, altitude and management for fourteen years, and data of fertility are examined. Significant evidence of differential responses of the two breeds are presented, and of the meteorological factors considered, the mean temperature at time of service is shown to exert the greatest influence.

PARIS

Academy of Sciences, July 15.—G. **Bigourdan**: The mean errors of the various modes of observation of the time signals. Over their longest paths, the perturbations of Hertzian waves have no influence on the time of transmission exceeding 0.01 sec. The error due to the mode of reception of the waves is of the same order of magnitude.—René **Lagrange**: The uniform deformation of a beam and the equation $\frac{\partial^4 F}{\partial x^4} + 2\frac{\partial^4 F}{\partial x^2 \partial y^2} + \frac{\partial^4 F}{\partial x^4} = 0$.— — **Eydoux**: The graphical determination of the meridian lines of turbine blades.—P. **Choux**: The Cupanieæ of Madagascar.—A. **Tronchet**: Vascular acceleration in schizocotyly.—Alexandre **Lipschutz**: Unilateral phenomena resulting from castration.—Henri **Pottevin** and Robert **Faillie**: Work during walking.

CAPE TOWN

Royal Society of South Africa, June 17.—A. W. **Roberts**: A statistical inquiry into the population problem in South Africa. The rate of increase of the white population in the Cape Colony is subject to a cyclical variation completed in 170 years. The rate of increase has been decreasing during the past twenty years. In Natal, exact statistics go back to 1860, and again there is evidence of cyclical variation. The rate of increase has been steadily decreasing during the past ten or fifteen years. This condition is also found in the Orange Free State and the Transvaal. Early enumerations of the native population are not available. Those taken in recent years indicate a declining rate in every instance but one, Zululand. The rate is increasing here, but very slowly.—W. J. **Copenhagen**: A note on Azotobacter in some South African soils. Soils from a number of localities in the Cape Province were examined and records made of the hydrogen-ion concentration, moisture, amount of organic matter, nitrogen per gram, characters of cultures, and nitrogen fixed per culture.—J. **Moir**: Colour and chemical constitution, Pt. xx. Some residual problems.

ROME

Royal Academy of the Lincei, June 5.—P. **Burgatti**: Conditions of validity of Lagrange's equations.—U. **Cisotti**: Fundamental equations of potential laminary motions on any surface.—G. **Armellini**: A theorem on the problem of two bodies of increasing masses.—N. **Parravano** and G. **Malquori**: Reactivity of silver with oxygen.—C. F. **Parona**: New observations on the chalks with *Heterodiceras Luci* of the Parenzo coast in Istria.—Gaetano **Rovereto**: New observations on the crystalline mass of Savona.—E. **Carano**: Detailed development of the female gametophyte of *Euphorbia dulcis L.*—Fil. **Bottazzi** and L. **De Caro**: Further results on the variations in the electrical resistance of muscles caused by solutions having different P_H values.—A. L. **Herrera**: Imitation of the smallest details of the Microsporidia by means of calcium fluosilicate.—Gianna **Calzolari**: Totality of analytical functions.—Mineo **Chini**: Determination of the geodetics of certain surfaces.—Gaetano **Scorza**: Complex algebraics connected with groups of infinite order.—Vasco **Ronchi**: A new stellar interferometer.—A. **Ferrari**: Crystalline lattices and isomorphism of lithium and magnesium fluorides. The structure of magnesium fluoride is of the rutile type, and the volumes of the elementary cells, containing four

molecules in the case of lithium fluoride and two in that of magnesium fluoride, are practically equal.—G. Canneri and L. Fernandes: Contribution to the study of certain minerals containing thallium: thermal analysis of the systems, $Tl_2S-As_2S_3$ and Tl_2S-PbS.—G. Scagliarini: Complexes of quinquevalent molybdenum.—Ardito Desio: The geological constitution of some of the smaller islands of the Dodecanese.—C. Jucci: Races of silkworms with three or four mutations. Study of crosses.

Official Publications Received

Journal of the College of Agriculture, Hokkaido Imperial University, Sapporo, Japan. Vol. 12, Part 3: Some Studies on a Japanese Apple Canker and its Causal Fungus, *Valsa Mali*. By Kogo Togashi. Pp. 265-324+plates 27-30. Vol. 15, Part 4: On the *Platypodidae* of Formosa. Supplementary Notes on "The *Platypodidae* of Formosa," by Jozo Murayama; Notes on the Japanese *Mantispidae*, with Special Reference to the Morphological Characters. By Satoru Kuwayama. Pp. 197-267+plates 12-16. (Sapporo.)

Proceedings of the Cambridge Philosophical Society. Vol. 22, Part 5, July. Pp. 601-812. (Cambridge: At the University Press.) 10s. net.

Union of South Africa: Department of Agriculture. Science Bulletin No. 39: Streak Disease of Sugar Cane. By H. H. Storey. Pp. 30. (Pretoria: Government Printing and Stationery Office.) 3d.

Meddelanden från Statens Skogsförsöksanstalt. Häfte 22, No. 1: Grundvattenrörelser och Försumpningsprocesser belysta genom Bestamningar av Grundvattnets syrehalt i Nordsvenska Moräner: Grundwasserbewegungen und Versumpfungsprozesse durch Sauerstoffanalysen des Grundwassers nordschwedischer Moränen erläutert. Av Olof Tamm. Pp. 44. Häfte 22, No. 2: Vattnadsundersökningar å tall och gran: Recherches sur la marche de l'accroissement chez le pin et l'épicéa durant la période de végétation. Av Lars Gunnar Romell. Pp. 45-124. (Stockholm.)

The Journal of the Institute of Metals. Vol. 33. Edited by G. Shaw Scott. Pp. xii+710+15 plates. (London: 36 Victoria Street.) 31s. 6d. net.

Eugenics in Relation to the New Family and the Law on Racial Integrity: including a Paper read before the American Public Health Association. Second edition. Pp. 32. (Richmond, Va.: Bureau of Vital Statistics, State Board of Health.)

University of California Publications in American Archaeology and Ethnology. Vol. 22, No. 1: Wiyot Grammar and Texts. By Gladys A. Reichard. Pp. 215. (Berkeley, Cal.) 2.75 dollars.

Aeronautical Research Committee: Reports and Memoranda, No. 963 (Ae. 179): Notes on Stalled Flying. By Squadron Leader R. M. Hill and H. L. Stevens. (A. 2 b. Stability Full Scale Experiments, 22—T. 1757.) Pp. 9+1 plate. 6d. net. Reports and Memoranda, No. 964 (Ae. 180): The Control of a Stalled Aeroplane as affected by the Use of Differential Ailerons. By H. L. Stevens. (A. 2 a. Stability Calculations and Model Experiments, 88—T. 1986.) Pp. 5+2 plates. 6d. net. Reports and Memoranda No. 965 (Ae. 181): Pitching and Yawing Moments with Sideslip on a Model Aeroplane with Zero Stagger. By F. B. Bradfield. (A. 2 a. Stability Calculations and Model Experiments, 91—T. 2021.) Pp. 14+5 plates. 1s. net. Reports and Memoranda No. 970: Report of the Airworthiness of Airships Panel. (D. 1. Special Technical Questions, 115—T. 1944.) Pp. 19. 9d. net. (London: H.M. Stationery Office.)

The National Physical Laboratory: Watch and Chronometer Trials, 1923-24. Pp. 7. (London: H.M. Stationery Office.) 6d. net.

Imperial Department of Agriculture for the West Indies. Report on the Agricultural Department, Montserrat, 1922-23 and 1923-24. Pp. iv+50. (Barbados.) 6d.

Otago University Museum and Hocken Library. Annual Reports for the Year 1924. Pp. 16. (Dunedin, New Zealand.)

Society of Chemical Industry: Chemical Engineering Group. Proceedings, Vols. 5 and 6a, 1923-1924. Pp. x+130. (London: Abbey House, Victoria Street.) 10s. 6d.

Empire Cotton Growing Corporation. Report on the Cotton Growing Industry in Uganda, Kenya and the Mwanza District of Tanganyika; with Map of the Eastern Province of Uganda. By Col. C. N. French. Appendices 1 and 2 by W. C. Jackson. Pp. 44. (London: Empire Cotton Growing Corporation.) 1s. 3d.

The Indian Forest Records (Silviculture Series), Vol. 11, Part 7: Volume Tables for *Tectona grandis* (*Teak*) and *Shorea robusta* (*Sal*) for the Central Provinces. By V. K. Maitland. Pp. 8+4 plates. 9 annas; 11d. (Entomology Series), Vol. 11, Part 8: The Economic Importance and Control of the *Sal* Heartwood Borer (*Hoplocerambyx spinicornis* Newm., fam. *Cerambycidae*). By C. F. C. Beeson and N. C. Chatterjee. Pp. ii+47+8 plates. 1.4 rupees; 2s. 3d. (Calcutta: Government of India Central Publication Branch.)

Forest Bulletin No. 59 (Economy Series): Summary of Results of Treated and Untreated Experimental Sleepers laid in the various Railway Systems of India, brought up to date. By J. H. Warr. Pp. 34+4 plates. 1.14 rupees; 3s. 3d. Forest Bulletin No. 61 (Botany Series): Eucalyptus in the Plains of North West India. By R. N. Parker. Pp. 34. 5 annas; 6d. (Calcutta: Government of India Central Publication Branch.)

Empire Cotton Growing Corporation. Reports received from Experiment Stations for the Seasons 1923, 1924 and 1925 (South Africa only). Pp. 48+9 plates. (London: Empire Cotton Growing Corporation.)

Department of the Interior: Bureau of Education. Bulletin, 1924, No. 39: Visual Education and the St. Louis School Museum. By Carl G. Rathman. Pp. iv+36. Bulletin 1925, No. 2: Important State Laws relating to Education enacted in 1922 and 1923. Compiled by William R. Hood. Pp. iv+82. (Washington: Government Printing Office.) 10 cents each.

State of Connecticut: Public Document No. 24. Forty-seventh Annual Report of Connecticut Agricultural Experiment Station, being the Annual Report for the Year ended October 31, 1923. Pp. viii+534+xlviii+26 plates. (New Haven, Conn.)

Department of Commerce: Bureau of Standards. Technologic Papers of the Bureau of Standards, No. 284: A Study of the Seasonal Variation of Radio frequency Phase Difference of Laminated Phenolic Insulating Materials. By J. L. Preston and E. L. Hall. Pp. 223-234. (Washington: Government Printing Office.) 5 cents.

Agricultural Experiment Station, Michigan Agricultural College. Special Bulletin No. 143: Winter Pruning the Black Raspberry. By Stanley Johnston. Pp. 22. Special Bulletin No. 145: Christmas Tree Plantations. By A. K. Chittenden. Pp. 9. Special Bulletin No. 146: Air Cooled Storage for Apples. By Roy E. Marshall. Pp. 54. Special Bulletin No. 147: Cherry Leaf Spot: Residual Effects and Control. By W. C. Dutton and H. M. Wells. Pp. 15. (East Lansing, Mich.)

Annual Report of the Board of Regents of the Smithsonian Institution showing the Operations, Expenditures and Condition of the Institution for the Year ending June 30, 1923. (Publication 2758.) Pp. xii+578+100 plates. (Washington: Government Printing Office.) 2 dollars.

The Institution of Civil Engineers. Engineering Abstracts prepared from the Current Periodical Literature of Engineering and Applied Science published outside the United Kingdom. Supplement to the Minutes of Proceedings of the Institution. Edited by W. F. Spear. New Series, No. 23, April. Pp. 203. (London: The Institution of Civil Engineers.)

Smithsonian Miscellaneous Collections. Vol. 77, No. 5: Solar Variation and Forecasting. By C. G. Abbot. (Publication 2825.) Pp. 27. Vol. 77, No. 6: Solar Radiation and Weather, or Forecasting Weather from Observations of the Sun. By H. H. Clayton. (Publication 2826.) Pp. 64. Vol. 77, No. 7: Solar Radiation and the Weekly Weather Forecast of the Argentine Meteorological Service. By Guillermo Hoxmark. (Publication 2827.) Pp. 28. (Washington: Smithsonian Institution.)

Ministry of Public Works, Egypt: Zoological Service. Publication No. 38: Report on the Zoological Service for the Year 1923, in which is included the 25th Annual Report of the Giza Zoological Gardens. By Major S. S. Flower. Pp. iii+20. (Cairo: Government Publications Office.) 5 P.T.

Diary of Societies

SATURDAY, AUGUST 29.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE (at Southampton), at 8.—Dr. F. A. Dixey: Mimicry in relation to Geographical Distribution (Lecture for Young People).—At 8.—Prof. E. V. Appleton: The Rôle of the Atmosphere in Wireless Telegraphy (Citizens' Lecture).

MONDAY, AUGUST 31.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE (at Southampton), at 10 A.M.—Prof. C. H. Desch: The Chemistry of Solids (Presidential Address to Section B).—Prof. A. V. Hill: The Physiological Basis of Athletic Records (Presidential Address to Section I).—Dr. J. B. Orr: The Inorganic Elements in Animal Nutrition (Presidential Address to Section M).—At 3.—W. H. Barker: The Development of Southampton in relation to World Commerce (Lecture for Young People).—At 5 (Section K).—Dr. D. H. Scott: Some Points in the Geological History of Plants (Lecture).—At 8.—Capt. P. P. Eckersley: Some Technical Problems of Broadcasting (Citizens' Lecture).

TUESDAY, SEPTEMBER 1.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE (at Southampton), at 3.—Prof. W. J. Dakin: Whaling in the Southern Ocean (Lecture for Young People).—At 8.—C. J. P. Cave: The Highway of the Air (Citizens' Lecture).

INSTITUTE OF METALS (Autumn Meeting, Glasgow), at 8 P.M.—Sir John Dewrance: Education, Research, and Standardisation (Lecture).

WEDNESDAY, SEPTEMBER 2.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE (at Southampton).

INSTITUTE OF METALS (Autumn Meeting, Glasgow), at 10 A.M.—A selection from the following papers:—R. J. Anderson and E. G. Fahlman: The Effect of Low Temperature Heating on the Release of Internal Stress in Brass Tubes.—Prof. J. H. Andrew and R. Hay: Colloidal Separations in Alloys.—J. S. Brown: The Influence of the Time Factor on Tensile Tests conducted at Elevated Temperatures.—L. H. Callendar: Passification and Scale Resistance in relation to the Corrosion of Aluminium Alloys.—R. B. Deeley: Zinc Cadmium Alloys: A Note on their Shear Strengths as Solders.—J. W. Donaldson: Thermal Conductivities of Industrial Non-Ferrous Alloys.—Prof. O. W. Ellis: The Influence of Pouring Temperature and Mould Temperature on the Properties of a Lead Base Anti-Friction Alloy.—Dr. Marie L. V. Gayler: On the Constitution of Zinc Copper Alloys containing 45 to 65 per cent. of Copper.—Dr. R. H. Greaves and J. A. Jones: The Effect of Temperature on the Behaviour of Metals and Alloys in the Notched Bar Impact Test.—Dr. D. Hanson and Dr. Marie L. V. Gayler: On the Constitution of Alloys of Aluminium, Copper and Zinc.—Dr. J. L. Haughton and W. T. Griffiths: The β Transformations in Copper Zinc Alloys.—Dr. H. Hyman: The Properties of some Aluminium Alloys.—D. H. Ingall: The High Temperature Tensile Curve: (a) Effect of Rate of Heating; (b) Tensile Curves of some Brasses.—C. H. M. Jenkins: The Physical Properties of the Copper Cadmium Alloys Rich in Cadmium.—G. B. Phillips: The Primitive Copper Industry of America.—D. Stockdale: The Alpha Phase Boundary in the Copper Tin System.

THURSDAY, SEPTEMBER 3.

INSTITUTE OF METALS (Autumn Meeting, Glasgow), at 10 A.M.—A selection from the papers given above.

Supplement to NATURE

No 2913 AUGUST 29, 1925

The Figure and Constitution of the Earth [1]

By Prof HORACE LAMB, Sc D, LL D, F R S, President of the British Association

WHEN one is confronted, as on this occasion, with the British Association in plenary session, it is permissible, I hope, to indulge in a few reflections on the nature and purpose of science in general The theme is no new one and has never been discussed so frequently as in our time, but the very range of our activities entitles us to consider it from our own point of view The subjects treated at these meetings range, according to the titles of our Sections, from the most abstract points of mathematical philosophy to the processes of agriculture Between these limits we have the newest speculations of astronomy and physics, the whole field of the biological sciences, the problems of engineering, not to speak of other matters equally diverse These subjects, again, have become so subdivided and specialised that workers in adjacent fields have often a difficulty in appreciating each other's ideas, or even understanding each other's language What then is the real purpose of science in the comprehensive sense, what is the common inspiration, the common ambition, behind such enthusiastic and sustained effort in so many directions ?

The question may seem idle, for a sort of official answer has often been given It was deemed sufficient to point to the material gains, the enlarged powers, which have come to us through science, and have so transformed the external part of our lives The general aim was summed up in an almost consecrated formula "to subdue the forces of Nature to the service of man", and since it was impossible to foresee what abstract research might or might not provide a clue to something useful, the more speculative branches of science were not only to be tolerated, but also to be encouraged within limits, as ancillary to the supreme end And, it must be said, the cultivators of these more abstruse sciences have themselves been willing sometimes to accept this position The apologists of pure mathematics, for example, have been wont to appeal to the case of the conic sections, which from the time of Apollonius onwards had been an entirely detached study, but was destined after some 2000 years to guide Kepler and Newton in formulating the laws of the planetary motions, and so ultimately to find its justification in the Nautical Almanac

I will not stop to examine this illustration, which I personally think rather strained We may recognise that practical utility has been a conscious though not the sole aim in much scientific work, and sometimes perhaps its main justification, but we can scarcely admit that any such formula as I have quoted worthily conveys what has been the real inspiration of discovery through the ages If we may go back to Apollonius and the conic sections, we cannot suppose that he was thinking of posterity at all, he was engaged in a study which he no doubt held to be legitimate and respectable in itself Or, to take a very recent instance, when Faraday and Maxwell were feeling their way towards an electric theory of light, they could scarcely have dreamed of wireless telegraphy, though, as we now know, this was no remote development The primary aim of science as we understand it is to explore the facts of Nature, to ascertain their mutual relations, and to arrange them so far as possible into a consistent and intelligible scheme It is this endeavour which is the true inspiration of scientific work, as success in it is the appropriate reward The material effects come later, if at all, and often by a very indirect path

We may, I think, claim for this constructive task something of an æsthetic character The provinces of art and science are often held to be alien and even antagonistic, but in the higher processes of scientific thought it is often possible to trace an affinity The mathematician, at all events, is at no loss for illustrations of this artistic faculty A well-ordered piece of algebraical analysis has sometimes been compared to a musical composition This may seem fantastic to those whose only impression is that of a mass of curious symbols, but these bear no more resemblance to the ideas which lie behind them than the equally weird notation of a symphony bears to the sounds which it connotes or the emotions which these evoke It is no misplaced analogy which has led enthusiasts to speak of the poetical charm of Lagrange's work, of the massive architecture of Gauss's memoirs, of the classic perfection of Maxwell's expositions The devotees of other

[1] Inaugural address delivered to the British Association at Southampton on August 26

sciences will be at no loss for similar illustrations. Is it not the case, for example, that the widespread interest excited by the latest achievements of physical science is due not to the hope of future profit, though this will doubtless come, but to the intrinsic beauty as well as the novelty of the visions which they unfold?

It is possible, I trust, to insist on these aspects of the scientific temperament without wishing to draw a sharp and even mischievous antithesis between pure and applied science. Not to speak of the enormous importance in our present civilisation of the material advantages which have come in the train of discovery, it would be disloyal to science itself to affect to depreciate them. For the most severely utilitarian result comes often as the result of a long and patient process of study and experiment, conducted on strictly scientific methods. We must recognise also the debts which pure science in its turn owes to industry, the impulse derived from the suggestion of new problems, and not least the extended scale on which experiment becomes possible. Reference may appropriately be made here to the National Physical Laboratory, initiated mainly in the higher interests of industry, which by the mere pressure of the matters submitted to it is becoming a great institute of theoretical as well as applied science, informed throughout by the true spirit of research.

But perhaps the most momentous consequences of the increased scientific activities of our time have been on the intellectual side. How profound these have been in one direction we have recently been reminded by the centenary of Huxley. Authority and science were at one time in conflict over matters entirely within the province of the latter. The weapons were keen and the strife bitter. We may rejoice that these antagonisms are now almost obsolete; one side has become more tolerant, the other less aggressive, and there is a disposition on both sides to respect each other's territories. The change is even reflected in the sermons delivered before the British Association. The quarters where we may look for suspicion and dislike are now different; they are political rather than ecclesiastical. The habit of sober and accurate analysis which scientific pursuits tend to promote is not always favourable to social and economic theories, which rest mainly on an emotional if very natural basis. Some of us, for example, may remember Huxley's merciless dissection of the theory of the social contract. There is hence to be traced, I think, a certain dumb hostility which, without venturing on open attack, looks coldly on scientific work except so far as it is directed to purposes of obvious and immediate practical utility.

There is a more open kind of criticism to which we are exposed, which we cannot altogether ignore, though it again rests on a misconception of the true function of science. It is to be met with in quarters where we might fairly look for countenance and sympathy, and is expressed sometimes with great force, and even eloquence. The burden is one of disappointment and disillusion; we even hear of the "bankruptcy of science." It seems to be suggested that science has at one time or other held out promises which it has been impotent to fulfil; that vague but alluring hopes which it has inspired have proved delusive. It may be admitted that extravagant and impossible claims have sometimes been made on behalf of science, but never, I think, by the real leaders, who have always been most modest in their claims and guarded in their forecasts. It is true, again, that in the enthusiasm which attended the first sensational developments of modern industry, hopes were conceived of a new era where prosperity would ever increase, poverty would be at least mitigated and refined, national antipathies would be reconciled. When these dreams did not swiftly come true there was the inevitable reaction; the idols were cast down, and science in general has rather unreasonably come in for its share of depreciation. The attitude which I have been trying to describe is put very forcibly in a quotation from President Wilson which I saw not long ago, though its date is not very recent:

"Science has bred in us a spirit of experiment and a contempt for the past. It made us credulous of quick improvement, hopeful of discovering panaceas, confident of success in every new thing. ... I should fear nothing better than utter destruction from a revolution conceived and led in the scientific spirit. Science has not changed the laws of social growth or betterment. Science has not changed the nature of society, has not made history a whit easier to understand, human nature a whit easier to reform. It has won for us a great liberty in the physical world, a liberty from superstitious fear and from disease, a freedom to use nature as a familiar servant; but it has not freed us from ourselves."

The tone is one of bitter disillusion, but we may ask why should science, as we understand it, be held responsible for the failure of hopes which it can never have authorised? Its province, as I have tried to define it, is vast, but has its limits. It can have no pretensions to improve human nature; it may alter the environment, multiply the resources, widen the intellectual prospect, but it cannot fairly be asked to bear the responsibility for the use which is made of these gifts. That must be determined by other and, let us admit it, higher considerations. Medical science, for example, has given us longer and healthier lives; it is not responsible for the use which we make of those lives. It may give increased vitality to the wicked as

well as the just, but we would not, on that account, close our hospitals or condemn our doctors.

In spite of the criticisms I have referred to, we may still hold up our heads, let us hope without arrogance, but with the confidence that our efforts have their place, not a mean one, in human activities, and that they tend, if often in unimagined ways, to increase the intellectual and the material and even the æsthetic possessions of the world. In that assurance, we may rejoice that science has never been so widely and so enthusiastically cultivated as at the present time, with so complete sincerity, or (we may claim) with more brilliant success, or even with less of international jealousy.

Passing from these reflections, which are, I hope, not altogether inopportune, it is expected that the president of the British Association should deal with some subject in which he has himself been interested. For a mathematician this obligation is a specially difficult one, if he is not to overstrain the patience of his audience. I propose to speak briefly, and mainly from the mathematical and physical point of view, about some branches of geophysics, and in particular those relating to the constitution of the earth. It is a subject which in the past has often engaged the attention of the Association. I need only recall the names of Kelvin and George Darwin, and the controversies with which they are associated. Historically, it is of special interest to the mathematician and the physicist, for it was in his researches on the figure of the earth that Laplace initiated the theory of its potential, with its characteristic equation, and so prepared the way for Poisson, Green, Cauchy, and a host of followers, who developed the theory of electricity and ultimately that of light. To go further back, it was in this connexion that Newton found an important verification of his law of gravity. Quite recently, the whole subject has been reviewed in a valuable treatise by Dr. Jeffreys, who arrives at conclusions which are at all events definite, and maintained with great ability.

I do not propose to deal with the fascinating speculations as to the past history of the earth and its reputed child, the moon, which will be more or less familiar. I must confine myself to a rapid survey of the information as to its present constitution, which can be gathered from observations made in our own time, and capable of repetition at will. This, though less exciting, is at all events a region in which imagination is more subject to control.

The accurate investigation of the figure of the earth is intimately connected with the variation of gravity over its surface. In view of the local irregularities, some convention was necessary as to what is meant by the shape of the earth as a whole. The usual definition is that it is a level surface as regards the resultant of true gravity and centrifugal force: often that particular level surface of which the sea forms a part. I need not dwell on the immense amount of theoretical and practical labour which has been devoted in various countries to the determination of the geometrical surface which most nearly satisfies this requirement. Of more recent interest are the irregularities in the intensity of gravity, which have been found to exist over wide areas, by the highly trained Survey of India, by the Coast and Geodetic Survey of the United States, and by various observers on the continent of Europe. Briefly, the general result is this, that in mountainous regions the observed value of gravity is abnormally low, whilst on oceanic islands, and so far as can be ascertained on the sea, it is abnormally large, when all allowance has been made for altitude and the normal variation with latitude. The fact that this has been found to be the case in so many different places, shows that we have here to deal with no casual phenomenon.

The accepted explanation, originated by Archdeacon Pratt, of Calcutta, in 1859, and since developed by Hayford and Bowie, of the U.S. Survey, is that if we imagine a level surface to be drawn at a depth of about 100 kilometres, the stratum of matter above this, though varying in density from point to point, is approximately uniform, in the sense that equal areas of the surface in question bear equal weights. The altitude of the mountains is held to be compensated by the inferior density of the underlying matter, whilst the oceanic hollows are made up for by increased density beneath. Leaving aside the technical evidence on which this hypothesis is based, there are one or two points to be noticed. In the first place it suggests, as is highly plausible on other grounds, that the matter in the interior of the earth, below the stratum referred to, is in a state of purely hydrostatic stress, *i.e.* of pressure uniform in all directions. So far as this stratum is concerned, it might be floating on an internal globe of liquid, although no assertion is really made, or is necessary, to this effect. But in the stratum itself, shearing forces must be present, and it is necessary to consider whether the actual material is strong enough to withstand the weight of continents and mountains, and the lack of lateral support due to the oceanic depressions. The researches of Prof. Love and others show that this question can fairly be answered in the affirmative.

The accurate determination of the acceleration of gravity at any place is, of course, a matter of great delicacy. Not to mention other points, in the pendulum method the yielding of the support due to the reaction of the pendulum as it swings to and fro affects

the time of oscillation. It may be recalled that, so far back as 1818, Kater, in his absolute determination of the length of the seconds pendulum in London, was on his guard against this effect, and devised a test to make sure that it was in his case negligible. In a portable apparatus, such as is used for comparative determinations, it is difficult to give sufficient rigidity to the support, and a correction has, in some way, to be applied. Recently, Dr. F. A. V. Meinesz, of the Dutch Survey, who has carried out an extensive gravity survey in Holland, has sought to minimise this effect by the use of pairs of pendulums swinging in opposite phases, and so reacting on the support in opposite senses. This has opened out a prospect of accurate gravity determinations at sea. The use of a pendulum method on a surface vessel is scarcely possible, but a submarine when sufficiently immersed offers comparative tranquillity, and it is hoped that the small residual horizontal motions may be capable of elimination, and the diminished vertical oscillation allowed for. The methods previously employed at sea which could claim any accuracy are those of Hecker. In one method, the pressure of the atmosphere is found in absolute measure from the boiling point of water and compared with the gravitational measure afforded by the barometer. In a more recent method, also devised by Hecker, and followed with some modifications by Duffield, the idea is to carry about a standard atmosphere, *i.e.* a mass of air at constant volume and prescribed temperature, the pressure of which is measured gravitationally by the barometer. Both methods are highly ingenious, but cannot compete as regards accuracy with the pendulum method if this should be found practicable.

It is a matter of regret that the observational side of geophysics has of late been so little cultivated in Great Britain. In India, with its wide opportunities, geodetic and gravitational work has long been carried on with high efficiency, and has furnished essential material for the generalisations I have referred to. But in the Home country, although we have an admirable topographical survey, nothing so far as I know has been done towards a gravity survey since the time of Kater, more than a century ago. Proposals for the establishment of a formal Geodetic Institute, such as existed in some other countries before the War, which should embrace this as well as other subjects, have been urged, but have had to be abandoned owing to the exigencies of the time. It is therefore some satisfaction to record that a modest beginning has been made at Cambridge by the institution of a readership in geodesy, and that, when the requisite pendulum outfit is complete, it is hoped that a gravity survey of the British Isles may be initiated. The physical features are scarcely so rugged that sensational results such as were found in India are to be expected; but it is desirable that the work, which will involve comparatively little labour and expense after the initial steps, should be carried out. The example of Holland shows that in a country which has no outstanding features at all, a survey may reveal peculiarities which are at all events of considerable interest. I may add that it is contemplated that the Cambridge apparatus should also be designed to eliminate the disturbing element I have mentioned, and that it should be available for determinations at sea. It is perhaps not too much to hope that, with the co-operation of the Navy, the gravity chart of the world, which is so far almost a blank as regards the ocean, may in this way be gradually filled in.

The distribution of the intensity of gravity over the surface of the earth gives by itself no positive information as to the distribution of density throughout the interior, though the contrary view has sometimes been held. For example, a spherical globe with a uniform intensity of gravitation over its surface would not necessarily be homogeneous, or even composed of spherical strata each of uniform density, however plausible this might be on other grounds. Consequently, there is room for hypothesis. There are certain tests which any hypothesis has to satisfy. It must account for the observed distribution of gravity, and having regard to the phenomena of precession, it must give the proper relation between the earth's moments of inertia about a polar and an equatorial axis. It may be added that it should be fairly consistent with the ascertained velocities of seismic waves at different depths, and the degree of elasticity which it is allowable to assign to the material. The somewhat artificial laws of density adopted by Laplace and Roche, respectively, mainly on grounds of mathematical convenience, have lost much of their credit. A more natural law, suggested indeed by Thomson and Tait in 1867 in their book on natural philosophy, has since been proposed in a more definite form by Wiechert. On this view, the earth is made up of a central core of about four-fifths the external radius, of high density, about that of iron, surrounded by an envelope of about the density of the surface rocks. This is, of course, only to be taken as a rough picture, but it satisfies the requirements I have mentioned, and is apparently not incompatible with the seismic data.

In all speculations on the present subject, considerations as to the thermal history of the earth and the present distribution of temperature in the interior play an essential part. The apparent inconsistency between the requirements of physics and geology was long a matter of controversy, and has given rise to keen debate at British Association meetings. Lord Kelvin's historic attempts to limit the age of the earth, by consideration of the observed temperature gradient as we go downwards from the surface, lost their basis when it was discovered that the rate of generation of heat in the processes of radioactive change was amply sufficient to account for the present gradient, and would even be far more than sufficient unless the amount of radioactive material concerned were strictly limited. Assuming an average distribution of such material similar to what is found near the surface, a stratum of some 16 kilometres in thickness would provide all that is wanted. Radioactive speculation has gone further. A comparison of the amounts of uranium, and of the end-products associated with it, has led to estimates of the time that has elapsed since the final consolidation of the earth's crust. The conclusion is, that it must lie definitely between 10^9 and 10^{10} years. The figure is necessarily vague owing to the rough value of some of the data, but even the lower of these limits is one which geologists and biologists are, I believe, willing to accept, as

giving ample scope for the drama of evolution. We may say that physics has at length amply atoned for the grudging allowance of time which it was once disposed to accord for the processes of geological and biological change.

The radioactive arguments on which these estimates are based are apparently irrefutable; but from the physical point of view there are reasons why one would welcome an extension even of the upper limit of 10^{10} years if this could possibly be stretched. For if this barrier be immovable, we are led to conclusions as to the present internal temperature of the earth which are not quite easy to reconcile with the evidence as to rigidity to be referred to in a moment. In the space of time I have mentioned, enormous as it is, the great mass of the earth could scarcely have cooled very much from the temperature when it was in a state of fusion. The central portion, whatever its nature, and however high its thermal conductivity, is enclosed by a thick envelope of feebly conducting material, just as a steam boiler, for example, may be jacketed with a layer of asbestos. To take a calculable hypothesis, we may assume with Wiechert that we have a central core of three-fourths the earth's radius, with an outer shell of rock. We may give the core any degree of conductivity we like; for mathematical simplicity we may even regard it as infinite. Then, if the outer layer consists of material having some such conductivity as the surface rocks, the internal temperature would take to fall to one-half its original value a period of at least ten times the limit I have named. It is obvious that the details of the assumption may be greatly varied without affecting the general conclusion of a very high internal temperature.

The question as to the degree of rigidity of the earth has so often been dealt with that a brief recapitulation must suffice. It was about the year 1862 that Kelvin first pointed out that if the earth as a whole were only as rigid as a globe of glass or even steel, it would yield so much to the deforming action of the solar and lunar tidal forces as seriously to affect the amplitudes of the oceanic tides, which are a differential effect. Unfortunately, the tides are so much complicated by the irregular distribution of land and sea that a comparison with the actual values of the theoretical amounts which they would have on the hypothesis of absolute rigidity is hopeless. The fortnightly tidal component, due to the changing declination of the moon, is probably an exception, but the difficulty here is to extract this relatively minute component from the observations, and the material is consequently imperfect. The problem was attacked in a different way by G. and H. Darwin in 1881. The horizontal component of the lunar and solar disturbing forces must deflect the apparent vertical, and it was sought to measure this effect by a pendulum. The quantities to be determined are so excessively minute, and the other disturbing forces so difficult to eliminate, that the method was only carried out successfully by Hecker in 1907, and afterwards by Orloff in Russia. The results on the whole were to the effect that the observed deflexions were about three-fifths of what they ought to be if the earth were perfectly unyielding, and were, so far, in accordance with estimates previously made by Darwin and others, from the somewhat imperfect statistics of the fortnightly tide.

There was, however, a discrepancy between the results deduced from the deflexions in the meridian and at right angles to it, which gave rise to much perplexity. The question was finally set at rest by Michelson in 1916. He conceived the idea of measuring the tides produced in two canals (really two pipes half filled with water) of about 500 feet long, extending one N. and S., the other E. and W. These tides are, of course, of a microscopic character, their range is of the order of one-hundredth of a millimetre, and they could only be detected by the refined optical methods which Michelson himself has devised. The observations, when plotted on a magnified scale, exhibit all the usual features of a tide-gauge record: the alternation of spring and neap tides, the diurnal and semi-diurnal lunar tides, and so on. The theoretical tides in the canals can, of course, be calculated with great ease, and the comparison led to the result that the ratio which the observed tides bore to the theoretical was about 0.69, being practically the same in both cases. The whole enterprise was as remarkable for the courage of its inception as for the skill with which it was carried out, and was worthy of the genius which has accomplished so many marvels of celestial and terrestrial measurement. The perplexing discrepancy in the results obtained by Hecker at Potsdam is no doubt to be explained by the attraction of the tidal waters in the not very remote North Sea, and by the deformation due to the alternating load which they impose on the bottom. In Chicago, near the centre of the American continent, these influences were absent.

The question may be asked: What is the precise degree of rigidity which is indicated by these observations, or by others which have been referred to? Various answers have been given, based on observations of the tides, of the lunar deflexion of the vertical, and of the period of the earth's Eulerian nutation, on which I have not touched. The estimates have varied greatly, but they are all high, some of them extremely high. That they should differ among themselves is not surprising. The material is certainly not uniform, either in its elastic properties or the conditions to which it is subject, so that we can only speak of the rigidity of the earth as a whole in some conventional sense. Larmor and Love have shown that all the information that can be gathered, whether from the tides or from the Eulerian nutation, can be condensed into two numerical constants. This leaves a large degree of indeterminateness as to the actual distribution of elasticity within the earth. It is at all events certain that in regard to tidal forces the great bulk of the material must be highly rigid.

In leaving this topic, it may be recalled that it was in this same connexion that Kelvin was led to initiate the method of harmonic analysis as applied to the tides, as well as to accomplish much brilliant mathematical work, the importance of which is by no means limited to the present subject. The whole theory of the tides and cognate cosmical questions afterwards became the special province of George Darwin; but after his death, work on the tides was almost at a standstill until it was resumed by Prof. Proudman and his associate, Dr. Doodson, in the recently established Tidal Institute at Liverpool. They have already arrived at results of great theoretical as well as practical interest.

Within the last twenty years or so, light has come on the elastic properties of the earth from a new and unexpected quarter, namely, from a study of the propagation of earthquake shocks. It is pleasant to recall that this has been largely due to efforts especially fostered, so far as its means allowed, by the British Association. To John Milne, more than to any one else, is due the inception of a system of widely scattered seismological stations. The instruments which he devised have been improved upon by others, notably by Galitzin, but it is mainly to his initiative that we are indebted for such insight as has been gained into the elastic character of the materials of the earth, down, at least, to a depth of half the radius. It may be remarked that the theory of elastic waves, which is here involved, was initiated and developed in quite a different connexion, in the persistent but vain attempts to construct a mechanical representation of the luminiferous ether which exercised the mathematical physicists of a generation or two ago. It has here at length found its natural application.

One of the first problems of seismologists has been to construct, from observation, tables which should give the time which an elastic wave of either of the two cardinal types, namely, of longitudinal and transverse vibration, takes to travel from any one point of the earth's surface to any other. It has been shown by Herglotz and Bateman that if these data were accurately known it should be possible, though naturally by a very indirect process, to deduce the velocities of propagation of the two types throughout the interior. Such tables have been propounded, and are in current use for the purpose of fixing the locality of a distant earthquake when this is not otherwise known. They are, however, admittedly imperfect, owing to the difficulty of allowing for the depth of the focus, which is not always near the surface, and is sometimes deep-seated. This uncertainty affects, of course, the observational material on which the tables are based. Some partial corrections have been made by Prof. Turner, who almost alone in Great Britain, amidst many distractions, keeps the study of seismology alive, but the construction of accurate tables remains the most urgent problem in the subject.

Taking the material, such as it is, however, the late Prof. Knott, a few years ago, undertook the laborious task of carrying out the inverse process of deducing the internal velocities of the two types of waves referred to. Although it is possible that his conclusions may have to be revised in the light of improved data, and, it may be, improved methods of calculation, they appear to afford a fairly accurate estimate of the wave velocities from the surface down to a depth of more than half the earth's radius. Near the surface the two types have velocities of about 7.2 and 4 km. per second, respectively. These velocities increase almost uniformly as we descend, until a depth of one-third the radius is reached, after which, so far as they can be traced, they have constant values of 12.7 and 6.8 km. per second, which, by the way, considerably exceed the corresponding velocities in iron under ordinary conditions. The innermost core of the earth, *i.e.* a region extending from the centre to about one-fourth of the radius, remains somewhat mysterious. It can certainly propagate condensational waves, but the secondary waves are hard to identify beyond a distance of 120° of arc from the source of disturbance. Knott himself inferred that the material of the central core is unable to withstand shearing stress, just as if it were fluid, but this must at present remain, I think, uncertain.

It should be remarked that the wave-velocities by themselves do not furnish any information as to the elasticities or the density of the material, since they involve only the ratios of these quantities. The relation between the two velocities is, however, significant, and it is satisfactory to note that it has much the same value as in ordinary metals or glass.

It is to be regretted that at present so little is being done in the way of interpretation of seismic records. Material support in the way of more and better equipped stations is certainly needed, but what is wanted above all is the co-ordination of such evidence as exists, the construction of more accurate tables, and the comparative study of graphical records. These latter present many features which are at present hard to interpret, and a systematic comparison of records of the same earthquake obtained at different stations, especially if these are equipped with standardised instruments, should lead to results of great theoretical interest. The task will be a difficult one, but until it is accomplished we are in the position of a scholar who can guess a few words in an ancient text, possibly the most significant, but to whom the rest is obscure.

Even on this rapid review of the subject, it should be clear that there is an apparent inconsistency between the results of two lines of argument. On one hand, the thermal evidence points to the existence of a high temperature at a depth which is no great fraction of the earth's radius, so high indeed as to suggest a plastic condition which would readily yield to shearing stress. On the other hand, the tidal arguments, as well as the free propagation of waves of transversal vibration at great depths, indicate with certainty something like perfect elasticity in the mathematical sense. The material with which we are concerned is under conditions far removed from any of which we have experience; the pressures, for example, are enormous; and it is possibly in this direction that the solution of the difficulty is to be sought. We have some experience of substances which are plastic under long-continued stress, but behave as rigid bodies as regards vibrations of short period, although this combination of properties is, I think, only met with at moderate temperatures. It is conceivable that we have here a true analogy, and that the material in question, under its special conditions, though plastic under steady application of force, as for example centrifugal force, may be practically rigid as regards oscillatory forces, even when their period is so long as a day or a fortnight. But beyond that we can scarcely, with confidence, go at present.

I have chosen the preceding subject for this address, partly because it has not recently been reviewed at these meetings, and also for the opportunity it has given of urging one or two special points. It is evidently far from exhausted—the loose ends have indeed been manifest—but this should render it more interesting. It furnishes also an instance, not so familiar as some, of the way in which speculations which appear remote from common interests may ultimately have an important influence on the progress of science. It is true that

the secular investigations into the form of the earth's surface have an importance in relation to geodesy, but certainly no one at the time of Laplace's work on this matter would have guessed that he was unwittingly laying the foundation of the whole mathematical theory of electricity. The history of science is indeed full of examples where one branch of science has profited by another in unexpected ways. I would take leave just to mention two, which happen to have specially interested me. It is, I think, not generally understood what an important part the theory of elasticity played in Rayleigh's classical determinations of the relative weights of the gases, where it supplied an important and indeed essential correction. Again, the mathematical theory of hydrodynamics, in spite of some notable successes, has often been classed as a piece of pure mathematics dealing with an ideal and impossible fluid, elegant indeed, but helpless to account for such an everyday matter as the turbulent flow of water through a pipe. Recently, however, at the hands of Prandtl, it has yielded the best available scheme of the forces on an aeroplane, and is even being appealed to to explain the still perplexing problem of the screw propeller.

To promote this interaction between different branches of science is one of the most important functions of the British Association, and differentiates it from the various sectional congresses which have from time to time been arranged. We may hope that this meeting, equally with former ones, may contribute to this desirable end.

Let me close with a local reference. The last fifty years have seen the institution of local universities and university colleges in many parts of Great Britain and of the Empire at large. Through these agencies the delights of literature, the discipline of science, have been brought within the reach of thousands whose horizons have been enlarged and their whole outlook on life transformed. They have become centres, too, from which valuable original work in scholarship, history, and science, has radiated. The University College of Southampton is now contemplating an increased activity and a fuller development. In this ambition it has, I am sure, the best wishes of us all.

Scientific Problems and Progress

SUMMARIES OF ADDRESSES OF PRESIDENTS OF SECTIONS OF THE BRITISH ASSOCIATION [1]

THE NEW IDEAS IN METEOROLOGY

THERE have been great advances in the science of meteorology during recent years which have completely revolutionised our conception of the structure and mechanism of the atmosphere. Dr. G. C. Simpson devoted his presidential address to Section A (Mathematics and Physics) to a description of the chief of these advances, dividing his address into four parts, each dealing with one of the new ideas on which these advances are based.

(1) *The Thermal Stratification of the Atmosphere.*—By using the idea of entropy, Dr. Simpson showed that the atmosphere can be marked off into nearly horizontal shells which have the peculiar property that air which starts in any one shell cannot be transferred to any other shell and remain there in equilibrium unless heat is added or subtracted. Thus, in all atmospheric motion in which heat is neither added nor extracted, the air must travel along the shell in which it started. These shells act like physical restraints to the air, tending to prevent its moving in any but an almost horizontal direction. Occasionally the air contains sufficient water-vapour to supply, when it condenses, the heat necessary to pierce the thermal stratification, but these occasions are practically confined to thunderstorms and to the rain squalls in the doldrums. The thermal stratification of the atmosphere prohibits the ascent of warm air at the equator and descent of cold air at the poles which has generally been considered to be the cause of the general circulation of the atmosphere, on the analogy of a gigantic hot-water system.

(2) *The Mechanism of the Atmospheric Heat Engine.*—The old idea that the energy received from the sun is converted into the energy of winds by the air near the ground being warmed and rising, like the hot air in a chimney, is obviously unsound. The thermal stratification prevents this action in all but exceptional cases. In place of this mechanism a new one is introduced. Masses of air from equatorial regions and from polar regions are brought side by side in middle latitudes. The cold polar air tends to subside and flow under the warm equatorial air which rises up the flank of the cold wedge which the polar air presents to it. When cold and warm air which were originally side by side react in this way, there is an appreciable lowering of the centre of gravity of the two masses taken together. Thus potential energy is released and appears as the energy of winds.

(3) *The Significance of Surfaces of Discontinuity in the Atmosphere.*—The surfaces at which relatively cold and warm masses of air meet and slide over each other as just described can easily be recognised on meteorological charts and by observations in the upper atmosphere. It is found that nearly all cloud is formed at such surfaces. Dr. Simpson discussed the conditions under which these surfaces of discontinuity can be maintained for long periods, and their significance in weather forecasting.

(4) *The Origin and Structure of Cyclones.*—The recent work of Bjerknes and Exner was described, according to which cyclones are formed where masses of air of polar and equatorial origin are brought together, and readjustment takes place in the manner described above. The old idea of a cyclonic depression being a kind of chimney drawing air in below and delivering it at the top can no longer be held.

These new ideas have had a far-reaching effect on the practical application of meteorology. Instead of the old empirical method of forecasting, the forecaster now has much more knowledge of what may be called the anatomy of a depression. He searches his charts for indications of the surfaces of discontinuity and examines the characteristics of the air masses to see whether they are of polar or equatorial origin. This has all resulted in greater confidence on the part of the forecaster, a confidence which is frequently justified by remarkably accurate forecasts.

[1] The collected presidential addresses delivered at the meeting are published under the title "The Advancement of Science, 1925," at 6s., or obtainable at the bookstall at Southampton by members at 4s. 6d.

The Chemistry of Solids

In his presidential address to Section B (Chemistry), Prof C H Desch shows that the wonderful progress of physical theory in recent years has brought about a tendency to treat chemistry as a deductive science, the reactions of elements and compounds being deduced from the electronic constitution of their atoms The chemical hypotheses of atoms, of molecular structure, of the benzene ring, of tetrahedral carbon, and of the periodic classification were devised in order to explain purely chemical observations, without reference to questions of ultimate reality, but modern physical investigations have shown them to represent Nature far more closely than their authors had supposed This result should encourage chemists to continue on paths which have led to success before, rather than to base further work purely on an application of physical theory The teaching of chemistry suffers from excessive and premature specialisation

Attention is directed in particular to a comparatively neglected field of research, that of the chemistry of solids, by which are meant crystals and aggregates of crystals The X-ray method has demonstrated the arrangement of atoms in crystals, and their mechanical properties have been extensively studied, but the relation between these and their chemical behaviour is obscure The complication due to the unknown properties of the intercrystalline boundary may be eliminated by the use of single crystals, several of the metals having been prepared in this form Reactions within a solid require the possibility of diffusion for their completion, and the evidence on this question is reviewed by Prof Desch, as are the reasons for the variations of habit among crystals Attempts which have been made to determine the distribution of the solute atoms in a crystalline solid solution by chemical means have lead to the conclusion that isomeric solid solutions are possible The study of the chemical properties of solids has been carried furthest in metallography, but is of importance also to chemical industry and to petrology

Cultural Aspects in Geology

Prof W A Parks, in his presidential address to Section C (Geology), expressed the opinion that it is sometimes thought that the sciences are purely utilitarian and materialistic, they have, however, a high cultural value also in that they induce contemplation and bring their devotees into touch with the infinite Geology, by reason of its breadth and its historical aspect, is particularly serviceable to this end In both the organic and the inorganic worlds a tendency to greater and greater complexity is observed—from a universe of hydrogen to a maximum of chemical complexity, from a vibrant particle of protoplasm to man The great age of the earth, probably 2,000,000,000 years, is a promise of still further duration, and the steady upward tendency of life is a promise of further development in the same direction

Despite great geological changes, there have always been land and water, due to a marvellous nicety of adjustment between destructive and reconstructive forces Similarly, although climatic changes have been great, the temperature of the earth as a whole has been such that life has been possible from the earliest geological time to the present

In the evolution of organisms, approximation to perfect adaptation is the herald of destruction New races arise from less closely adapted stems, and the "missing links" are necessarily few and, owing to migration, are to be sought in stratigraphically oblique lines Evolution is not brought about by some mysterious force acting on all organisms The birth of a new phylum is a distinct event in time, and it does not bring about the extinction of the parent phylum For example, sponges arose from Protozoa in the pre-Cambrian, and never since have the Protozoa fathered other than unicellular offspring

Geological conditions govern most human activities, but those with a strong historical setting are particularly cultural For example, a knowledge of the potential energy of Niagara Falls is not necessarily "culture," but that word may be applied to a recognition of the fact that Niagara Falls exist because some millions of years ago a layer of hard limestone was deposited over soft shales The great principles of geology have had less effect on literature than might have been expected this is particularly true of poetry Among the major poets, Tennyson stands in first place in this respect Strange to say, the principles of evolution and the great animals of the past seem to have inspired more doggerel verse than true poetry

Organic Evolution

In his presidential address to Section D (Zoology), Mr C Tate Regan stated that his work on fishes has led him to the conclusion that the first step in the origin of a new species is the formation of a community, either with new habits or in a new or restricted environment In Nature there is every gradation from morphologically identical communities to others so distinct that every one is agreed that they are well-marked species, thus the morphological discontinuity said to be characteristic of species is seen to be the final term of a habitudinal discontinuity that began with the formation of communities at first structurally similar These ideas were illustrated by a detailed account of some species and communities of Salmonidæ

The same principles apply to evolution in general, it has been adaptive, changes of structure have followed changes of habits, and especially changes of food and feeding habits The origin and evolution of the neopterygian fishes illustrates well how modifications that were originally adaptive become historical, they persist, and become the basis for further adaptive modifications

The natural selection theory is the only adequate explanation yet given of certain classes of facts, but it is a very unconvincing explanation of other classes, which lead to the conclusion that adaptive responses, repeated generation after generation, are consequently made earlier and more effectively In the flat-fishes the cartilaginous bar above the eye that is going to migrate begins to be absorbed almost as soon as the fish is hatched, and while the fish is still externally symmetrical this bar becomes reduced to short processes of the otic and ethmoid cartilages, with a wide gap between them,

through this gap the eye migrates, so that when ossification takes place, one frontal bone is on the wrong side of its eye. This developmental history may be interpreted as the end result of a process initiated by the ancestral fish that first formed the habit of lying on one side, and tried to move the eye of the under side into a position where it could be of more use.

Many families of perch-like fishes, not at all closely related, have 24 vertebrae (10 praecaudal and 14 caudal), and there is good evidence that this is a primitive percoid character. Here there is no variation, and therefore no material for selection, nor can any fish alter the number of vertebræ during its life by the way it swims. Yet it seems clear that this fixity has been broken through over and over again, and that the number of vertebræ has increased or decreased from 24 whenever it was necessary. Thus Psettodes, the most primitive flat-fish, structurally an asymmetrical perch, has 24 (10 + 14) vertebræ; it is piscivorous, and probably lies in wait and makes short dashes after fishes that come near enough. But other flat-fishes, which swim along the bottom with undulating movements, have many more vertebræ; the sole, for example, has about fifty. It seems that the muscular activities of a fish, its efforts to swim in a certain way, may produce a change in the number of muscle segments of its descendants. This may be condemned as a teleological speculation, but it is put forward as a hypothesis that fits the facts, and as preferable to the mutation hypothesis, which in effect states that it is only by accident that a structure has a function.

The Science and Art of Map-making

After reference to Colonel Clarke as a distinguished citizen of Southampton, whose name is now to be commemorated by a tablet on the house where he lived, the president, Mr. A. R. Hinks, of Section E (Geography), expressed his lasting regret that Clarke's figure of the earth (1880) has not been chosen as standard by the International Conference at Madrid. With a glance at recent improvements in instruments Mr. Hinks discussed the modifications required in geodetic practice to cope with local attraction, referred to the intended reorganisation of time signals, and urged the establishment of British signals through the Imperial wireless chain. Dealing next with air-photographs and stereographic survey, he advocated reliance on ground stations, and an earnest attempt to apply the stereographic method to work on geographical scales. A summary of recent developments in map projections led to discussion of the International Map on 1/1,000,000, with the conclusion that its actual production should have been entrusted to a single establishment; that a smaller scale would have sufficed for much of the world; and that the work of the Permanent Committee on Geographical Names for British Official Use would be incomplete without a British map.

Turning then to the art of map-making, Mr. Hinks discussed the effect of multiple printings in colour, British pre-eminence in layer-colouring, and the need for some improved mechanism for drawing or typing names. There has been a lamentable decline in the craftsmanship of both instruments and maps. The former dates from the application of the telescope, at an epoch when other crafts were at their highest point of artistic merit. The decay in map-drawing came later, and may be repaired by diligent study and adaptation of early styles, rejecting the modern exaggerated use of distinguishing physical features by differences of lettering; but above all, avoiding sham medievalism.

The Meaning of Wages

In discussing this extremely thorny problem in her presidential address to Section F (Economics), Miss Lynda Grier stated that no satisfactory theory of wages has as yet been formulated. Meanwhile, different interpretations of the word are accepted, varying with the aspects from which wages are considered. Wages are sometimes discussed as normal wages only, *i.e.* wages which represent the value of the work done under conditions of free competition. This value may be low, even when the work done is important and the workers do it competently, if there are many workers competing for a limited number of jobs and incapable of undertaking work of a different kind. When this is the case, the rest of the community gains by cheap services.

Frequently, however, wages are discussed as yielding an income which does or should maintain the worker. Up to a point the normal wage must supply sustenance in order to secure efficient workers. But it is not based on calculations of the length of the worker's life, of the cost of rearing him, of the size of his family, of the possibility of his death leaving a widow and children to be provided for. There is no necessity for employers to consider these things; few workers can afford to consider them. The normal wage takes account of the needs of the worker only when their satisfaction affects directly the supply or efficiency of labour. Beyond this point, needs are a weakness rather than a strength in bargaining.

Wage payments may be raised above the normal rate when demand for the product of labour is inelastic. In general, however, they can only be so raised by limiting the number of workers employed; the normal wage being the price at which all workers belonging to a particular grade can be employed in the occupations to which they are admitted. Attempts, legislative and non-legislative, to stretch wages to cover expenses not reckoned in normal wages are made at the risk of unemployment. Additions to low wages may be made with justice, since cheap labour which is not bad labour may provide cheap goods and since the worker is often not responsible for the cheapness of his labour. Moreover, all admit the necessity for some redistribution of wealth; but redistribution of wealth made in the name of wages may lead to a bad distribution of labour.

Fifty Years' Evolution in Naval Architecture and Marine Engineering

Sir Archibald Denny, in his address to Section G (Engineering), traced the rise in the steam pressures used in marine engineering, and the passing from the simple to the compound engine, and from that to the triple and quadruple, which were practically universal in 1897. The appearance of the little *Turbinia* at the Spithead review in 1897 heralded a revolution in marine steam practice, which was at once embodied in the order placed by the Admiralty

in 1898 for the torpedo-boat destroyer *Viper*, and later in the mercantile marine, by the commissioning of the *King Edward* in 1901

At first applicable only to the faster vessels, in 1909, after the conversion of the *Vespasian* from triple to geared turbine by Parsons, single gearing widened the scope of the turbine, and later double reduction gearing made it applicable to all types of sea-going vessels

Dr Diesel, who began developing the internal combustion engine for marine purposes in 1897, saw the fruits of his labours in trading vessels a few years before the War Since the War, development has been exceedingly rapid, and indeed some enthusiasts claim that the days of the steam turbine are numbered for marine work The reply of the steam turbine designer is higher steam pressures with superheat, pre-heating of the air to the furnaces, and stage heating of the feed water, etc

There has been an enormous development in auxiliary machinery, both in the pursuit of economy and in providing for the greater comfort and convenience of the passenger and personnel As to main engine power in any one hull, in 1875 3000 I H P was considered high, whereas now the highest in mercantile practice is 75,000, and in naval vessels 140,000 I H P is found

In the ship itself the changes in design and the growth in dimensions and draught have been many, while the developments in accommodation for passengers have been such that the third class of to-day travel at speeds and in a comfort which was not available to the first-class passenger of 1875, while now the first class have at their disposal all the comforts and luxury found "at home" Many changes in design were made possible when mild steel supplanted iron in the early 'eighties of last century, and present-day metallurgical researches make further advances probable

Attention is directed to the various agencies which have assisted in the advances made, especially the influence of technical education, which in 1875, so far as workers in private works were concerned, was provided almost exclusively by evening classes under the guidance of the South Kensington Science and Art Department The Admiralty, however, had much better provisions in the dockyards for their own students The Admiralty training and the chairs in naval architecture which were later founded at three of our universities have had important influences on private works

The regulations of the Board of Trade and the classification societies, and also the private and public research at the universities and at the National Physical Laboratory, especially in the Froude experimental tanks of which there are now seventeen scattered throughout the world, have exerted important influences on shipbuilding Finally, there are the technical institutions, such as the Institution of Naval Architects, which have had much to do with the development of design, while the effect of standardisation, under the guidance of the British Engineering Standards Association, is also discussed

Practical Engineering in Ancient Rome

Dr T Ashby discussed the remains of engineering works in Italy in his presidential address to Section H (Anthropology), and stated that what appealed most of all to those who saw Rome in her prime were the aqueducts, the roads, and the drainage system The Cloaca Maxima is ascribed by tradition to the Etruscan Tarquins, and (though nothing of the original structure is left) it still performs its functions, its splendid construction bidding defiance to the lapse of time though, to our modern ideas, the direct discharge of sewage into the river seems dangerous

Besides the drainage system, much attention was bestowed upon the regulation of the banks of the river and upon the bridges which crossed it From there we pass naturally to the consideration of the road system, the nucleus of which dates from the beginning of Rome's history—of that wonderful network of roads which extended beyond Italy over the whole Roman Empire Here, too (confining ourselves to Italy alone), we find a number of interesting and important engineering works The Via Appia, the Via Traiana, and the Via Flaminia provide us with the best examples for study

Turning last of all to the aqueducts, we find that the most important for our purpose are the four aqueducts which drew their supplies from the upper valley of the Anio, the Anio Vetus (272–269 B C) and the Anio Novus (A D 38–52), taking their supplies from the river the name of which they bear, the Aqua Marcia (144–140 B C) and the Aqua Claudia (A D 38–52), from springs which rise in the floor of the river valley These aqueducts all required considerable restoration works, at more frequent intervals than one might have thought, and remains of the original channels of the two earlier aqueducts are rare, as indeed is to be expected, for they were built at a time when the danger of their being cut by an invader was still present

As the course of these four aqueducts is often almost identical, the distinction of their remains was much facilitated by levelling operations carried out in 1915 by the late Prof V Reina, while Dr Esther van Deman's researches on the chronology of the various types of construction employed in them are also of great importance The remains are worth close study in detail, and the course of the aqueducts, which, when Prof Lanciani's work was published in 1880, was still undetermined for several miles, has since been followed step by step, largely owing to his help

These works of practical engineering seem to have been carried out by military engineers, who were at the same time civil architects—all of them Roman citizens, and for the most part Italians, not Greeks The study of these works shows us that in this sphere, as in others, the Romans added very considerably to the sum of human achievement, and thus contributed in no small measure to make the condition of the human race what it is

The Physiological Basis of Athletic Records

In the records of athletics and of the various forms of racing there is a considerable store of accurate information as to the capacity of the human body for muscular effort, and the physiological basis of these achievements form the subject of Prof A V Hill's presidential address to Section I (Physiology) The most complete collection of such information is to be

found in the "World's Almanac and Book of Facts," published by the *New York World*; similar, though not so extensive information, is to be found in Whitaker's Almanack. The manner in which athletic records can be explained by, and can be used to illustrate, physiological principles is best shown by plotting graphically the average speed at which a race is run as a function of the total time occupied in the race. In this way, for the various types of muscular effort involved, we may construct curves for the ideal individual, showing how long an effort of any required intensity can be maintained. For the shorter durations of effort, say up to twenty minutes, the form of the curve may be explained simply on the ground of the supply of oxygen, actual or potential, available to the competing individual. The muscular system works like an electrical storage battery in the sense that severe exertion may be undertaken for a time at the expense of oxidation (*i.e.* recharging) occurring afterwards in the recovery process. For anything but the shortest races, however, the amount of oxygen available in the contemporary supply through lungs and circulation is also of importance.

The following cases are considered: running, men and women; swimming, men and women; walking, rowing, bicycling, skating, and horse-running. Of these, running and swimming are almost precisely similar in their general relationships: both represent extremely rapid and violent exertion. Rowing, bicycling, and horse-running are different: the two former certainly, the latter probably, because the same extreme violence of exertion is not possible as in running and swimming. For efforts of greater duration, as in skating, bicycling, and in running and walking long distances, the determining factors are quite different from those concerned with the immediate usage and supply of oxygen. Here other types of fatigue, of a nature less understood at present, are at work.

The importance of skill in movement is discussed, and it is pointed out how the curve relating oxygen requirement to speed of movement gives a full and complete account, for any given individual, of the skill which he exercises in movement at any speed: the greater the oxygen requirement, the less the skill. Given a sufficient oxygen intake and a sufficient capacity for running up an oxygen debt, the chief factor in athletic effort of anything but the shortest duration is the skill and economy with which it is carried out. For the very short effort, economy is of less importance; the essential thing is to attain the greatest possible output of energy. Quite astonishing amounts of power are exerted by athletes in violent efforts of short duration.

Some Issues in the Theory of "G" (including the Law of Diminishing Returns)

In his presidential address to Section J (Psychology), Prof. C. Spearman treated of certain points in a theory which has become known as that of two factors or of "g." According to this, every different ability of any person can be resolved into two factors, of which one is always the same but the other always independent; the factor always the same is intimately connected with what is commonly called "intelligence."

The proof falls into three distinct phases. The first is to ascertain what are the conditions under which the measurements of any ability admit of such division into two factors. The second is to find where, if at all, these conditions are actually fulfilled. The third and last phase is that of supplying the factors with some serviceable explanation; the hypothesis which at present seems most helpful is that the "g" measures some particular form of "energy" derived from the whole cortex of the brain. Recently, the first phase was greatly advanced by discovering a new and much improved criterion of the divisibility called the "tetrad-difference." This has now been applied to the results of an actual experiment which furnished 3003 of these tetrad-differences. The median value of these as predicted by the criterion was 0.061; that actually found came to 0.062.

The second part of Prof. Spearman's address discussed the fact that in some abilities the "g" is predominantly influential, in others the "s." Now, evidence has been brought to show that the more any class of persons is well endowed with "g," the smaller becomes the influence of "g" as compared with "s." It would therefore seem as if the more energy is available already, the less advantage accrues from further increments of it. An interesting parallel to this is the economic law of diminishing returns.

In the third part of his address, Prof. Spearman showed that a great number of abilities, since they are dominated by the influence of "s," vary independently from one individual to another. The inference can be made that in respect of the great bulk of these abilities, every individual will tend to be near the average; a fair number will be distinctly above this, and a fair number below; at the extreme ends of the frequency distribution will lie a very small number of performances for which the individual is, on one side a genius, and on the other an idiot. To find out where the genius of each person lies is a work that seems likely to have extremely important results, educationally, industrially, and even socially.

The Phæophyceæ and their Problems

The Phæophyceæ or brown algæ present a wide range of plant forms; in regard to external form and structure the higher members are the most highly differentiated of the Thallophyta, while in size they exceed greatly any green or red alga. In their reproductive schemes and life-histories they show striking differences, although the uniformity of their motile reproductive cells, the similarity of the colouring matter, and the products of assimilation indicate their descent from a common stock.

According to the presidential address to Section K (Botany) by Prof. J. Lloyd Williams, interest in the group has been much increased by recent work and also by Dr. Church's memoirs on the marine origin of the land flora. Much work has been done on the various bodies found in the Phæophycean cell, but the disagreement between investigators as to the nature, origin, and even the functions of these bodies, shows the need for further research. A similar state of affairs prevails with regard to our knowledge of the reproductive organs. The group, with its very divergent reproductive methods, is good material for a rediscussion of the theory of "alternation of genera-

tions," the various types ranging from Pylaiella, with fluctuating alternations of gametophyte and sporophyte, to Fucus, which is variously described as showing (*a*) alternations with extreme reduction of the gametophyte, (*b*) nuclear alternation of generations, and (*c*) no alternations at all, the plant being a gametophyte

The address concluded with an appeal for increased study of the physiology and ecology of the brown seaweeds No survey is available of the marine algæ of Great Britain, and there is also great need of an up-to-date English manual of the group

The Warp and the Woof in Education

Education depends on a plan which includes the organisation and so much of the curriculum as is determined by the State, or by any other body in whom power is vested, and on the even more important contributions made by the teachers and by all the influences that surround the growing personality The former is, according to Dr W W Vaughan in his presidential address to Section L (Education), like the warp, the latter like the woof of the loom on which any fabric is woven

The warp is at present probably too complicated, certainly too uniform, and it must remain too uniform so long as the State, for what were once quite good reasons, feels bound to define closely the powers of the local authorities, the boundary lines between education at different ages and of different sorts, and the limits of any city's or district's aspirations What is now needed is that geographical units of reasonable size and homogeneity should be allowed to make real experiments, to set up warps of their own devising, receiving from the State in the way of grant what the State can afford to give and being allowed then to work out for that community a scheme of public education for the child, for the youth, and even for the man or woman

In order that this may be done, we must get rid of some prejudices and some ideals that have been haunting us or are beginning to haunt us One is that any extension of the school age must be uniform—applying to all children and to all places—another is that all are equally capable of fruitful education, another is that education cannot be won—and best won for some—by close contact with work that brings a livelihood, another is that education is to enable its recipients to have a happy leisure rather than to find happiness in daily work The bogies, too, of wasted ability and thwarted genius must not be allowed to terrorise us By all means do all that is possible—more indeed than is *done* now—to prevent waste, but do not let us be morbid in our fear of waste Excellence depends on waste Our careful precautions against waste lead to mediocrity

The woof at which teacher or parent or employer or public opinion is always working depends on a more understanding co-operation between all those and all citizens too For their goodwill alone can create the material circumstances in home and street that will prevent the influence of school being nullified by the influences that assail the impressionable mind in the hours of work, of leisure, and of recreation

It is this co-operation that we teachers must ceaselessly implore and boldly claim

The Mineral Elements in Animal Nutrition

In his presidential address to Section M (Agriculture), Dr J B Orr states that during the past half-century an increasing number of workers have become interested in the rôle played by inorganic salts in nutrition Eight or nine of the mineral elements, *e g* calcium, phosphorus, potassium, etc , are known to be essential constituents of living matter Iodine, manganese, fluorine, copper, zinc, and some others are found in traces The presence of these was at one time thought to be accidental, it is now believed, however, that most, if not all, are essential constituents of the body

The beginning of life-processes lies in the action of radiant energy on inorganic salts The carbon atom is harnessed as the most suitable vehicle for conveying the chemical energy formed The complex carbon-containing compounds, which have been regarded as the fundamental organic substances, are really secondary developments to secure that degree of stability and complexity required for the evolution of higher forms of life

In the animal body, changes in the concentration of the inorganic ions in the circulating fluid are correlated with changes in functions of the organs Thus, all the organs regulated by the central nervous system depend for the integrity of their function upon the maintenance of definite ratios of calcium, potassium, and sodium in the fluids within the nerve tissues The classical experiments of Ringer on the perfused heart show that minute changes in the concentrations of calcium or potassium in the perfusing fluids have a profound effect on the activity of the heart It is probable that the function of the bones in regulating the supply of mineral elements to maintain the "physiological balance" of the body fluid is as important as the more obvious one of providing a rigid framework It is probably more fundamental, for when the available mineral matter is insufficient to maintain both the physiological balance in the blood and the rigidity of the skeleton, it is rigidity which is sacrificed

When, for prolonged periods, the diet contains deficiencies or excesses of mineral elements greater than can be dealt with by the regulating mechanisms of the body, pathological conditions develop It has been found that these occur not infrequently under modern conditions of intensive production in animal husbandry Attempts to adjust the mineral content of diets by the addition of inorganic constituents that appear to be deficient meet, in many cases, with a marked degree of success In the present stage of our knowledge, perfect adjustment is impossible We need further information with regard to the amounts of each of the essential mineral elements required under different conditions, and the influence of the factors such as the "balance" of the diet and ultra-violet irradiation on the assimilation of mineral elements

Valuable results are likely to be yielded by investigations on the interactions of colloids and inorganic ions, on the influence of the electrical charge and chemical characteristics of the ion on these reactions, on the effects of radiant energy on the processes associated with mineral metabolism, and on the relationship of these to both normal and pathological processes in the body In this region there seems to lie the key to the solution of many obscure problems, both of the normal metabolism of health and of the abnormal metabolism of disease

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Cotton-Breeding, Plant Physiology, and Agriculture.

KNOWLEDGE of the cotton crop presents a curious antithesis to that of wheat. The effects of environment are better analysed and understood for cotton than for most crops, but whereas the genetic study of wheat is classical, that of cotton is fragmentary. About cotton we have practically no "useless" genetical information, such as may suddenly turn out to hold the key to commercial difficulties, and a recognition of this ignorance has been a factor in founding the new Empire Cotton Experiment Station in Trinidad. So far, this lack of knowledge has mattered less than it might have done, because Nature provides the cotton-breeder with ample occupation in merely isolating pure lines from the complex population which arises from the small amount of natural crossing in cotton. Thus, almost no successful application of synthetic genetics has been made to cotton, except by Leake.

A further complication of cotton-breeding (and a further justification of the Trinidad scheme) lies in its inability to be a self-contained science. The cotton-breeder has one foot in the physiologist's camp so long as he deals with the inheritance of dimensional characters; and while cotton is grown as a paying crop for spinning purposes, its dimensional characters take practical precedence of all others. This may or may not be the right attitude, but at least we may be sure that the dimensions—if inherited at all as such—are not inherited in isolation. The writer had some glimmering of this when, in the dawn of Mendelism, he started to record every recordable characteristic in one hybrid cotton; his simultaneous observation that there were about two dozen chromosomes was damping to enthusiasm, even in those pre-Morgan days, and the study of dimensions led him by insidious paths into physiology. There is, of course, no antagonism between genetics and physiology in cotton; rather they are much too intimate, so that their disentanglement is quite difficult.

Some illustrations of this intimacy are provided by the report from the Bombay Presidency of the second annual Conference of Plant Breeders held at Surat last spring. The very first group of papers not only dived into physiology, but came out on the other side, with a discussion on the probable error of field experiments, an omnibus subject if considered for what it really contains, but yet an end in itself for the economic side of agriculture. The reputed instability of certain improved varieties when grown by farmers was next discussed; and, though traced to the obliteration of small superiorities by local conditions, it led to a

recommendation that "adaptability to a large range of conditions should be the ideal in breeding improved races" It is more than doubtful whether this ideal can be realised Most species which adapt themselves to a wide range of conditions are complexes of elementary species, between which natural selection takes place on establishment in any fixed environment When such elementary species, or similarly pure lines of cotton, are tested for various environments, they have been found by the writer to exhibit most decided local preferences, in one pair of Egyptian strains the long staple became short in the Sudan while the short became long, in another pair the yields crossed over when moved from Cairo to the cooler sea-board Indeed, it seemed that if flexibility were wanted very badly, without abandoning the control of production-quality which pure lines give, then it would be necessary to issue blended seed containing more than one pure line The suggestion may seem absurd, but with cotton it is in any case essential to have a seed-renewal system, so that after the lapse of some three years, when the blended strains have intercrossed to a serious extent, the bulk seed supply would be due for renewal from the pure stocks It may be possible with some plants to eat one's cake and still possess it intact, but with cotton at least there seems to be a choice between putting stable pure lines into their appropriate environment or continuing to endure the inconvenience of unstable but plastic commercial "varieties"

A discussion on the possibility of standardising testing methods for different crops was held at Poona but does not seem to have been very helpful, as abridged in the report now before us Testing as testing is a rather futile process, whether of crop yield, yarn elasticity or metal hardness, it can aim only at establishing comparable facts, which are incidentally and inevitably numerical There is no test result known to the writer, in agriculture or textiles or engineering, for which he would not be glad to substitute an understanding of why the result was obtained Without such understanding, even if imperfect, some of the factors implicit in the test method will escape control, and the comparability of the facts established will thereby be invalidated More analytical, and much more physiological, was an account by Mr M L Patel of the competitive effects of adjacent plants in the crowd of a field crop, and the differences from one strain to another in this respect

Genetics as such does not appear until half-way through the Conference, with a note on natural crossing, also by Mr Patel The desirability of mass selection was then seriously questioned, though apparently without reaching the only definite conclusion possible, namely, that while mass selection is the first thing to do, it is also the worst thing to do, and is simply a stop-gap expedient We would like to hear more of the figures on which the next discussion was based, namely, "Acclimatisation and the Adaptation of Newly Imported Seeds" Few topics have been more thoroughly disintegrated than this by mere convictions, and any facts are of value The Conference did not commit itself in its conclusion, which wags a reactionary tail, it considered that "acclimatisation was a fact and that it might be (1) selection by climate of like individuals from an obvious mixture, and (2) selection by climate of a physiologically suitable race from a variety apparently pure for all external characters, or the gradual adjustment of some individuals of a variety to a new environment, and that it is desirable to consider each case on its own merits"

It is clear that the plant breeders of the Bombay Presidency do not lack material for investigation, nor are they geneticists only So far as can be judged from a brief report, it would seem that a useful service could be rendered to his fellows by some one who would dissect the complex story of plant-breeding into unit assertions—even if they were wrong—and definitions To have two main meanings and several subsidiary ones, some mutually contradictory, for a single word like "acclimatisation," does not facilitate discussion with fellow-workers, or afford explanation to the outsider W L B

Science at Oxford

Early Science in Oxford By R T Gunther Vol 3 Part I The Biological Sciences, Part II The Biological Collections Pp xii + 564 + 64 plates (Oxford The Author, Magdalen College, 1925) 42*s* net

THIS splendidly produced and entertaining volume is the third of a series which Mr Gunther has devoted to an account of the historic remains of scientific Oxford They stand as a permanent memorial of the subject of which they treat Like its predecessors, this volume is in the form of a catalogue, in which each heading is provided with a short introduction It differs from the generality of catalogues in being extremely readable, and in the capacity that its author exhibits to lead the reader from point to point Mr Gunther is to be heartily congratulated on an achievement involving a most unusual combination of persistence, scientific knowledge in many departments, self-devotion, and literary skill and charm

The history of science has two aspects, complementary one to the other It may be treated from the point of view of the development of scientific ideas, the historian tracing these ideas in reference to one another and to

the cognate thought of the successive ages This is the philosophical or psychological approach The exponents of this method usually pay but scant attention to the "false starts" in science, they ignore almost entirely the by-paths of the subject, and are more interested in methods and results than they are in the men who use one or attain the other On the other hand, the subject may be treated from the point of view of biography or of local history This is the antiquarian or archæological method In the ultimate analysis it is philosophically indefensible, since the scientific process, of its very nature, demands that the search for truth must be carried on without prejudice to persons, and that truth, when found, must be taken for what it is, without regard to its origin Science is the great leveller Should she bow the knee to any idol, whether of the tribe, the cave, the market-place, or the theatre, she loses her divine right But the antiquarian method is nevertheless very useful in another sense By it alone can we learn of the social and intellectual environment in which science yields effective fruit, and —what is no less important—by it we can learn of some of those insidious factors that render science sterile This knowledge is of evident practical application

Mr Gunther is an eminent exponent of the antiquarian method of scientific history The value and interest of his results are undeniable They have been justly greeted in his own University as containing a hitherto unwritten chapter in its long and varied history Mr Gunther is a genial and optimistic writer, a very loyal son of his *alma mater*, an admirable *raconteur* with a good eye and ear for the bizarre and ridiculous, which, however, never permit an interference with his enthusiasm for what is high and great Nevertheless, reflection on the results of his work does not summon up thoughts that are consoling or cheering

After enjoying these volumes, the contemplative reader will naturally ponder the end of all the endeavour that is there related Since the Revival of Learning, four hundred years ago, a great University has been equipped with great endowments assigned to scientific ends What have been the results? Let us discount the "amateur" who has ever borne an honoured place in British learning, but whose debt to his university has ended with his literary training Let us put him aside and make a proper balance sheet on one hand the endowments for scientific instruction, on the other the scientific achievements of those who have held, in this great and ancient University, the offices for the imparting of that instruction Mr Gunther rightly ends his book with a "Table of Succession of the Scientific Professors" It is the summary of the whole book, and is mournful reading On the credit side a few really great scientific names will be discerned, among them several of the founders of the Royal Society But apart from the last generation or two, and excluding this limited number of brilliant exceptions, the succession is one of scientific nonentities, mostly men who do not take even a secondary place in the annals of science

These fine volumes of careful studies thus bring out a fact that all interested in national education should take to heart It is that the best manner of obtaining scientific results can by no means be easily determined A very complex psychological question is involved Pious founders in the past and in the present have often thought that they could obtain good results by mere monetary gifts to some particular department of learning Men with affectionate memories of this school or that college seek to link the glory of an ancient foundation with that pure search for knowledge that can never be the property of a class or institution These volumes show how much of this seed, thus strewn with careless and generous, if ignorant enthusiasm, has fallen and will fall on sterile ground

The fact is that the production of an effective scientific atmosphere depends in the end on neither endowments nor institutions nor even good will, but on the intellectual outlook of society as a whole The lesson is to help to create that outlook and the rest will follow naturally The arrogant aloofness of the classical spirit of Oxford for centuries separated it from many of the movements that stirred the pulses of the people of England, and among them was the great scientific movement, the most important intellectual event of the last eighteen hundred years Shame it is on our humanity and to the memories of its creators, the great minds of Greece and Rome, to call such a spirit "humanism"! The price—and it is a heavy one—has been most surely paid for being the home of lost causes That phrase must not be lightly glossed as a mere joke or epigram It is a diagnosis of a grave and deeply seated spiritual malady From it Mr Gunther's University emerged into convalescence only in quite modern times His volumes will be read by posterity, but we believe that they will be read for the account that they contain of the course and symptoms of a very deadly disease

The Technology of Glass

A Text-book of Glass Technology By F W Hodkin and A Cousen Pp xxiii + 551 (London, Bombay and Sydney Constable and Co, Ltd, 1925) 42s net

FOR several years the glass industry of Great Britain has suffered from the lack of an up-to-date and authoritative text-book upon the technology of glass, but the deficiency has now been made good by

Messrs F W Hodkin and A Cousen All interested in glass will welcome the recently published compilation of these two authors, and the industry owes them a debt of gratitude for such a masterly exposition of their subject, which covers the whole field of glass manufacture Acting with admirable forethought, they have not stressed any one side of this manufacture above another, and throughout the work they have adhered to their determination as stated in the preface to attempt no encyclopædic survey, but to allow the book to take the simpler form of a general introduction to the study of glass technology In this they are to be commended, because the book becomes as valuable to the beginner as to the expert The latter may indulge his desire for more detailed knowledge by reference to original papers and to books specified in a well-arranged bibliography and in copious footnotes, whilst the beginner will find each chapter easy to assimilate, there being no extraneous matter to confuse him

The general arrangement of the volume will meet with approval, and it shows the stamp not only of experienced teachers but also of men who have a wide practical knowledge as well Commencing with a chapter upon the historical development of the glass industry, the work naturally divides itself into sections upon physical properties, raw materials, fuels, refractory materials, furnaces and glass-making processes No matter of importance is neglected, and each chapter is a mine of information upon the subject with which it deals To those whose knowledge of chemistry is limited, Chap ii dealing with the basis of glass technology will be found helpful, as it indicates in a simple manner how glass is produced from raw materials Chaps iii, iv, v and vi upon the physical properties of glass, whilst of interest generally, are of particular import to those in whose domain lie the devising of new glasses and the improving of old The question of thermal endurance is rightly stressed as this property is so important in every type of glass The various factors which determine this endurance are also fully discussed In this connexion, it would have increased the value of Table xv to have included with the compositions of the glasses shown, the thermal endurance values calculated from the Winkelmann and Schott relation However, the reader will find pleasant exercise in supplying the values for himself, using the various tables provided, which deal with density, tensile and crushing strength, elasticity, hardness, specific heat, expansion and the like It may be said regarding these tables that one deprecates the omission of the values of Winkelmann and Schott for the elasticity factors of the various constituents of glass (see *Ann d Phys u Chem*, 1894, p 711, and 1897, p 122)

One of the most valuable chapters in the book (Chap vi) deals with the question of the durability of glass, and it provides a very thorough survey of the knowledge accumulated upon this important subject A more detailed account of the apparatus used in testing for durability, together with diagrams of such apparatus, would not have been out of place and would have been found useful by manufacturers desiring to apply durability tests to their ware In comparing the effect of sodium oxide and potassium oxide upon durability, "Peddle's generalisation" might well have been included, namely

"In alkali—RO—silica glasses where RO is the oxide of calcium, barium, strontium, magnesium, zinc or lead, when the total alkali present is less than 20 per cent, a glass containing both alkaline oxides will be less soluble and more durable than the glass containing the same amount of alkali as sodium oxide or potassium oxide alone This is true whatever amount of silica or RO is contained in the glass"

The raw materials of the glass industry are dealt with in Chaps vii-xii The account given will be found full and up-to-date, in particular the pages dealing with the treatment of sands and the storage and mixing of batches A special feature of this section is the tabulating of more than 100 batches for glass-melting, the mixtures given ranging over most of the best known types To those who find difficulty in the calculation of batches for glass, Chap xi will appeal with especial force because the whole question of such calculations is treated in a very comprehensive manner Purists will quarrel with the authors when they write "$\frac{1}{2}K_2O$," etc, thereby implying the "half molecule of a compound," but the expression may perhaps be tolerated in this chapter as it simplifies calculation considerably

The authors deal with combustion and the evaluation of fuels in a very lucid manner, all the data being well marshalled and easy to assimilate Chapter xiv, upon combustion, is rendered all the more valuable by the inclusion of typical calculations, and these are treated in a fashion which commands admiration Throughout the volume, indeed, one cannot help being impressed by the facile manner in which calculations are worked out In view of the increasing recognition of the value of temperature control in all glass-working processes, Chap xvii, upon pyrometry, will arouse interest, and in it will be found a full account of the various devices for registering temperature in a glass works

The sections of the work that will appeal most to actual manufacturers are those upon producers, refractories and furnaces Chap xix, dealing with producers, has only to be read to be appreciated for it is a veritable storehouse of information Pride of place among the four chapters (xx-xxiii) upon refractory materials must be given to that which

describes the manufacture of glasshouse pots and blocks, because of the series of fourteen photographs illustrating the production of a pot Seven chapters in all (xxiv - xxx) are devoted to furnaces, and we have nothing but praise for the manner of treatment Numerous diagrams and photographs enhance the value of these chapters, which deal in sufficient detail with many types of furnaces, lehrs, and so on, without being at all verbose, whilst the discussion is without bias The principles of regeneration and recuperation receive full attention, and the respective merits and demerits of the two systems are emphasised

The volume ends with nine chapters upon glass-making processes This section will be of especial interest to the general reader as it serves to indicate the huge strides that have been taken during the present century in the manipulation of glass by machinery The most modern processes are ably dealt with and a wealth of photographs and of diagrams is included In this connexion it may be said that the whole book is admirably illustrated by more than 250 figures, many of them being full page in size

The indexing will be found comprehensive, sections being devoted to name index and subject index, whilst a word of praise is due to the proof-reading, which has been very thorough Very few errors will be met with in the text, and those of small importance

Economy and Efficiency in House-Heating

House Heating a General Discussion of the Relative Merits of Coal, Coke, Gas, Electricity, etc, as alternative means of providing for Domestic Heating, Cooking and Hot Water Requirements, with Special Reference to Economy and Efficiency By Dr Margaret Fishenden Pp 296 (London H F and G Witherby, 1925) 25*s* net

DR FISHENDEN has provided one of the most interesting books that has ever been written on a most important branch of domestic science Her work has been known for a considerable time to all those who are specially interested in the performances of domestic heating appliances, through valuable reports which have been issued from time to time by the Department of Scientific and Industrial Research The contents of these reports have now been collected and expanded so as to give greater continuity and comprehensiveness of treatment, with the addition of critical historical matter, and a wide public owes a debt of gratitude to Dr Fishenden for having undertaken the task, and having carried it through so well

The book begins with a preliminary consideration of fuels available, their composition, and the methods of production of such artificial fuels as town gas and coke A brief summary of the position of electricity as a heating agent, and of the reports of the Electricity Commissioners in relation to power supply terminates with the judgment "At present, however, even the fact that most electric heaters give efficiencies of practically 100 per cent theoretical, is not enough to counterbalance the low thermal efficiency and high cost of production"

Dr Fishenden goes on to treat of the development of the modern sitting-room grate, and justice is done to Count Rumford, who was advocating at the end of the eighteenth century ideas applied in the modern fireplace, and to Dr Pridgin Teale of Leeds, who enunciated detailed rules for the construction of fire grates, some of which are so generally adopted in the design of modern fireplaces that the author sets them out in full

Then we begin to see the kind of thing that Dr Fishenden has herself been doing in a paragraph headed "Fluctuations in the Rate of Burning of Coal Fires," accompanied by a number of diagrams indicating the variations in the intensity of radiation emitted from fires fed with coal, slack, and coke, stoked in different ways A study of the distribution of radiation from open fires was carried out on the general plan adopted in the "Leeds" tests, described in the first and second Reports of the Joint Gas Heating Research Committee of the University of Leeds and the Institution of Gas Engineers This chapter is very comprehensive It is appreciative as regards the method employed by Prof Boys in successfully burning gas coke on a flat firebrick hearth with an overhanging firebrick back, and the reverse of appreciative in dealing with the effect, or rather non-effect, of patent preparations on the efficiency of coal fires The importance of providing draught regulation with coal fires is insisted upon, and the common error in the older open fireplace of drawing far too much air through the room is emphasised The opportunity in installing a gas fire of realising a more efficient and economic arrangement in this respect is made very obvious A corresponding treatment is then given to the development of the kitchen range, the survival of which is attributed to the fact that it can meet so many different requirements, although it functions so uneconomically with respect to any one of them Dr Fishenden's conclusion is "It is probable that the independent boiler with open fire, with or without the addition of an oven, will gradually rise to a considerable degree of popularity, gas being used for cooking when no oven is included in the range"

The chapter on "The Development of Gas for Heating Purposes" is also very well done, and stress is rightly laid upon the ventilating effects of gas fires In the discussion of room heating it is too often

forgotten that the fire and the flue into which it works are serving a double purpose, and that from the hygienic standard the ventilation is at least as important as the heating Merely to warm the air in a room is insufficient, and in this lies the weakness of so-called "radiators" (which are mainly convectors), whether heated by steam or gas, and of nearly all the electric heaters

An interesting chapter follows upon the use of gas for cooking purposes, in which the "Standard Gas Cooker" proposals of the Standardisation Committee of the National Gas Council are detailed, and the new gas cooker of Messrs Radiation, Ltd, with its semi-automatic controlling device, are both described along with more specialised devices, such as the Radiophragm heating introduced by Prof Bone specially for toasting or grilling operations

As regards the efficiencies obtainable in gas heating and cooking appliances, the results of the Gas Investigation Committee of the Institution of Gas Engineers and the University of Leeds in Britain, and those of the Bureau of Standards in the United States, are widely quoted

Electricity for heating, cooking, etc, is given a chapter to itself, Dr Fishenden pointing out that "modern electrical cookers, like electrical heaters in general, can be considered to owe their origin to the discovery of nickel-chromium high resistance wires," which stand long contact with air at high temperatures Various types are discussed, and then in another short, but interesting, chapter the position of central heating by various methods is indicated and briefly discussed

In many ways the most important and useful chapter of all is that which brings the book to a close, but it is not easily summarised It is to be hoped, however, that this impartial and well-informed summary by a competent authority, who has given special attention to the subject, will be widely read, even by those who have not the time or perhaps the inclination to read the more detailed considerations of the preceding chapters It is a statement and an expression of reasoned opinion which comes at a time when it is very much wanted, in the first place, because a combination of circumstances is persuading or compelling householders to find out what are the most economical, cleanly, and healthy methods applicable for carrying out the heating operations required in their homes, and secondly, because without such information it is only too likely that catch-words may take the place of principles in forming public opinion and inducing legislative action

The reviewer does not mean that he would necessarily endorse in detail all the statements and conclusions made in this chapter, but he does regard it as an excellent attempt at summarising a very complicated matter Dr Fishenden begins by taking the costs of different fuels which would be sufficient, if completely burned, to produce one therm (or 100,000 B Th U), and then, with reasonable assumptions as to comparative efficiencies, points out that "with coal at 50*s* per ton, gas at 10*d* per therm and electricity at 1*d* per Board of Trade unit, an up-to-date open gas fire would cost about two and a half times as much as an open coal fire, whilst an electric heater would cost about five and a half times as much But it must be clearly understood that in this comparison equivalent heating values during continuous running have been the basis, and no allowance has been made for the saving in labour effected by the use of gas or electricity as compared with coal" For intermittent use, of course, the conditions become much more favourable for the more easily controlled methods of heating "In practice, owing to the fact that coal fires cost an appreciable amount to light, and involve a great deal of work in the carrying of coal, cleaning of grates, etc, gas fires for such periodic heating would generally prove to be decidedly cheaper than coal fires And even electric heaters, on the relative costs which have been taken, would sometimes, by their convenience and adaptability, repay for the higher cost of the units used"

One of the most useful portions of this chapter is that in which the author considers in turn heating appliances for large and small houses and for cottages, discriminating wisely between the requirements of one and another Her final sentence is "For almost every purpose which raw coal at present fulfils, smokeless domestic cokes would prove a satisfactory substitute, and used in conjunction with gas or electricity would enable all domestic heating, cooking, and hot water requirements to be carried out economically, with a complete absence of black smoke production"

One criticism the reviewer must make This book is very well printed, and the diagrams are numerous and clear, but it is surely a book for which a large circulation should be sought, and the price asked will scarcely allow of that object being attained JOHN W COBB

The Morphology of Crustacea

Studies on Arthropoda, II By Dr H J Hansen (Published at the expense of the Rask-Ørsted Fund) Pp 176 + 8 plates (Copenhagen and Berlin Gyldendalske Boghandel, London Constable and Co, Ltd, 1925) 15*s* net

SO long ago as 1893, Dr H J Hansen published in the *Zoologischer Anzeiger* a preliminary paper on the morphology of the limbs and mouth-parts in crustaceans and insects Many of the views adumbrated in that paper have since been adopted and developed by others, and some of them have been

further illustrated by the author himself in the course of systematic papers dealing with the varied groups of arthropods which he has studied. Now, after more than thirty years, we have the first part of the connected exposition of his morphological views, for which the earlier paper was to prepare the way. In this memoir, only the Crustacea are dealt with, the remaining divisions of the Arthropoda being reserved for a future part.

So far as it is not purely descriptive, Dr. Hansen's point of view may be said to be that of an idealistic morphology. He abjures phylogenetic speculation, and has nothing to say as to the structure of hypothetical ancestral forms. This was also the point of view of the great protagonist of Darwinism, whose centenary we have recently been celebrating. It was Huxley's opinion that "morphological generalisations ... will remain true, so far as they are true at all, even if it should be proved that every animal species has come into existence by itself and without reference to any other." It may perhaps be doubted, however, whether even Huxley was able to keep his morphology quite untainted by evolutionary speculation. Try as we may, we cannot look at things with the eyes of the pre-Darwinians, but it is right that we should be reminded how much in our phylogenies is sheer guesswork and how little justified is the confident dogmatism of "Haeckelismus."

Dr. Hansen describes in great detail, and illustrates in a series of finely engraved plates, the chitinous exoskeleton of the mouth-parts and limbs in the main subdivisions of the class Crustacea. He brings much additional evidence in favour of the view, now accepted by many authorities, that the sympod (protopodite of Huxley) is typically composed of three, instead of two segments. In the thoracic legs of Decapoda he finds that an additional segment, first observed by Coutière and here termed "præischium," is often indicated, and he bases on this a new scheme of comparison of the segmentation of the legs in the various orders of the Malacostraca. In this scheme the position of the "knee," or main flexure of the limb, is assumed to remain constant throughout the sub-class. On this point it is perhaps permissible to doubt whether the evidence is quite conclusive.

Dr. Hansen has no doubt that the trilobites should be regarded as Crustacea, rejecting, probably with justice, the arguments against this view drawn from the absence of a shell-fold and the sessile condition of the eyes. He thinks it impossible that the limbs can have been articulated, in the way described by Raymond and Walcott, to downgrowths of the dorsal skeleton, and, indeed, such a mode of articulation would be without parallel among recent arthropods.

In dealing with the Cirripedia, the interesting suggestion is put forward that the so-called "mandibles" of the adult may be the maxillulæ, the mandibles being lost in the course of development. This point might well engage the attention of embryologists.

Great importance is attached to Geoffrey Smith's description of a biramous mandibular palp in Paranaspides as giving the clue to the interpretation of the palp in other Malacostraca. No subsequent observer, however, has been able to see a trace of the biramous condition in Paranaspides, and there can be little doubt that Geoffrey Smith was misled on this point.

Many other points of general morphological interest are discussed in the course of this memoir, which deserves the close attention of all students of the Arthropoda.

W. T. C.

Education of Chimpanzees

The Mentality of Apes. By Prof. Wolfgang Kohler. Translated from the second revised edition by Ella Winter. (International Library of Psychology, Philosophy and Scientific Method.) Pp. viii+342. (London: Kegan Paul and Co., Ltd.; New York: Harcourt, Brace and Co., Inc., 1925.) 16s. net.

PROF. KOHLER'S book marks a distinct advance in comparative psychology, for he was able to study his chimpanzees in very favourable conditions of health and housing in Teneriffe. He also realised that these apes are characteristically social creatures and must be studied in companionship with their fellows. A chimpanzee is intellectually and emotionally bewildered if it is kept in solitary confinement. "It is hardly an exaggeration to say that a chimpanzee kept in solitude is not a real chimpanzee at all." Prof. Kohler's experiments were also marked by their critical carefulness. No emphasis is laid on single incidents; the crucial experiments were repeated many times. Generous descriptions were for the most part rejected.

The book gives abundant evidence of genuine intelligence or power of perceptual inference. Thus a chimpanzee will pile one box on the top of another to the number of four, in order to reach a banana fastened to the roof of the cage. In the course of a forenoon a clever chimpanzee discovered how to fit a short bamboo rod into the end of a longer and broader one, so that it was able to reach a prize lying beyond the bars. Even more striking was the prolonged biting at an unsuitable piece of wood so that it could be fitted into the bamboo rod, thus making a double stick. The apes often showed very precise observation, for example, of the spot on raked and featureless ground where they had seen some treasure

buried They recognised their teacher or a companion after prolonged absence, though on the whole, out of sight is out of mind to a chimpanzee A conspicuous feature was the restless inquisitiveness, it often seemed as if they liked trying for trying's sake They would feed the hens with bread which they themselves were not fond of, and would watch the details of the pecking with great interest—obviously the beginning of chimpanzeeish ornithology This they would prosecute by luring a hen close to the cage and then suddenly giving it a dig in the ribs with a stick Very quaint was the appreciation of a hand-mirror and the passage to the use of other things as mirrors, such as pieces of metal or even a pool of rain-water, at which they would stare long and intently, just as if self-consciousness was dawning Yet in spite of long-continued experiments, the apes never got away from the conviction that there was an elusive "other fellow" through the looking-glass For him they would lie in wait and at him they would make many a sudden pounce!

The particular limitations of chimpanzees seem to be their poor vocabulary and their slight capacity for working with "images" in the mind They solved many problems, such as those we have mentioned, but one condition of success is that they must be brought into circumstances where the factors that constitute the solution are all visibly given They must have all the facts of the case within their visual range The book seems to us a very valuable one its net result is to show that chimpanzees are very ingenious within a narrow range

Our Bookshelf

The Production and Measurement of Low Pressures By Dr F H Newman Pp 192 (London Ernest Benn, Ltd, 1925) 16s net

IN recent years the advance of physics, especially atomic physics, has required vacua of an ever-increasing perfectness, to this end a series of extremely ingenious methods and pieces of apparatus have been designed, most of which have only been developed after the fundamental principles underlying each of them were fully mastered At the same time manufacturers have availed themselves of these improved methods, and it is now common practice that methods of exhaust of the most recent type are employed in the production of commercial articles which require to be exhausted to the very highest degree In order to be able to measure such high vacua, gauges capable of such precise measurements have been developed, and it is, of course, only by advancing such means that the process of exhaust can be improved

Prof Newman in his book has given a very good description on both parts of this subject, after a short historical résume, he has given an excellent account of all modern high vacua exhaust apparatus, which will certainly be of great use to all concerned in such work, and from a large number of tables (some of which possibly might have been better expressed as a curve) has afforded the physicist or the vacuum engineer a sound basis from which he will be able to choose the type of apparatus suitable to his work

The effect of the size and length of connecting tubes on the rate of exhaust is dealt with and the importance of these factors is shown by a few examples There is a chapter on "Sorption," giving a good resume of the most important papers which have been published, after which comes an interesting chapter on "clean up," the process which plays such an important part in the modern methods of lamp and valve manufacture

The second section of the book deals with the measurement of pressure Here the different methods are fully described—each one being given space according to its practical uses or for its fundamental importance A chapter describes the exhaust procedure, in which is emphasised the care which has to be taken in the freeing of the container walls and electrodes from gas Prof Newman's short account of making glass to metal joints shows that he is unaware of the ease with which such seals are now carried out on a technical scale even up to a diameter of several inches As a whole the book is an excellent one and will be welcomed by all who are interested in the subject R LE R

The Indo-Sumerian Seals Deciphered discovering Sumerians of Indus Valley as Phœnicians, Barats, Goths and Famous Vedic Aryans, 3100–2300 B C By Dr L A Waddell Pp xxiv+146 (London Luzac and Co, 1925) 10s net

COL WADDELL, the well-known authority on Tibet, has stepped in where archæologists, as yet, fear to tread He has produced an interpretation of the remarkable seals which were found, with other relics suggesting an affinity with ancient Sumeria, at Mohenjo Daro and Harappa in the Indus Valley, and illustrated and described by Sir John Marshall, Director of the Archæological Survey of India, in the *Illustrated London News* in September of last year "Within a day or two of receiving the photographs," says Col Waddell, "I was able to decipher and read the greater part of the inscriptions on the seals"

According to Col Waddell's interpretation, the seals provide a record of the rulers of a Sumerian colony in the Valley of the Indus of the third millennium B C His system of interpretation is revolutionary and entails a complete revision of the results obtained hitherto in dealing with Mesopotamian records Detailed discussion of his conclusions would therefore be unprofitable without previous acceptance of the argument by which he justifies his method of attacking the problem This is based upon theories which have been expounded in part, though not entirely, in a previous publication in which an attempt was made to prove, not only that the Phœnicians were the ancestors of the Britons, Scots and Anglo-Saxons, but also that they were Aryans and the ruling Aryan class of India The kings of the early Aryan dynasties of India, it was maintained further, had never been in India, but were kings in western Asia and were to be identified with the kings of early Mesopotamia—Sumeria and

Akkad Col Waddell regards the seals as confirming his theories, but it must be obvious that an interpretation which is entirely individual depends upon, rather than confirms, a theory which still lacks conclusive demonstration For it must be stated that Col Waddell's views, particularly in so far as his etymological arguments are involved, have not met with the acceptance of those most competent to judge Until the author has brought forward more cogent arguments for the identification of the kings of the Indian lists with those of Mesopotamia—a subject with which it is understood he proposes to deal in a later work—the riddle of the seals remains unsolved

Aufgaben und Lehrsatze aus der Analysis Von Prof G Pólya und G Szego (Die Grundlehren der mathematischen Wissenschaften in Einzeldarstellungen, Band 19 and 20) Erster Band Reihen, Integralrechnung, Funktionentheorie Pp xvi+338 15 gold marks Zweiter Band Funktionentheorie, Nullstellen, Polynome, Determinanten, Zahlentheorie Pp x + 407 18 gold marks (Berlin Julius Springer, 1925)

MOST French and German mathematical text-books differ from the English books in one important particular they contain no examples for solution The working of problems and examples has long been one of the features of English mathematical teaching All able mathematical students of a generation ago were expected to gain practice in manipulation by solving hard problems Wolstenholme's problem book reflects the tendency of the period in which it was compiled, a large proportion of its examples being somewhat artificial in character despite the elegant solutions they admit Now the tendency is to avoid problems involving hard manipulation, it being considered that familiarity with mathematical subjects can be gained by working easy examples constructed to test a student's knowledge of fundamental principles The new Wolstenholme still remains to be written

Meanwhile, Prof Polya and Herr Szego, in the two volumes before us, have brought together some 1500 problems dealing with the subjects of analysis above noted A large proportion of the questions can be solved at sight, others involve results taken from research papers in the journals, and few readers will see through these without referring to the solutions The books will be of great value to honours students of pure mathematics in universities, and a lecturer will find innumerable suggestions for examples to set before his classes W E H B

Air Ministry Meteorological Office British Meteorological and Magnetic Year Book, 1917 Part 5 *Reseau Mondial, 1917* Monthly and Annual Summaries of Pressure, Temperature, and Precipitation at Land Stations, generally Two for each Ten-degree Square of Latitude and Longitude (M O, No 229 *g*, Tables) Pp xiv+116 (London H M Stationery Office, 1925) 22*s* 6*d* net

THIS publication deals with the weather results for the whole globe, and similar results are now available for the eight years 1910–1917 The means are compared with normals and the differences are given for each element for each station The statistics for each additional year add much of real scientific value in the direction of preparing for long-period forecasts It is now possible to see how excess or defect from the normal in one part of the world influences weather experienced in another part It is a fairly simple study to ascertain whether the pressure of the air at the earth's surface is practically uniform at different times over the whole globe All the information refers to land stations, no data over the sea being as yet obtainable The number of stations utilised is 458, which is an increase of 18 since the previous issue for the year 1916

The highest mean shade temperature for the year 1917 was 87° F at Sokoto and 86° F at Berbera, Somaliland, the lowest mean 6° F at Verkhoiansk The absolutely highest shade temperature recorded is 123° F at Baghdad on July 21 and at Jacobabad on June 11, the absolute lowest temperature was −81° F at Verkhoiansk on January 19 The heaviest total rainfall for 1917 was 9850 mm (388 in) at Cherrapunji, the least 1 mm at Iquique

Schlich's Manual of Forestry By Sir William Schlich Vol 3 *Forest Management, including Mensuration and Valuation* Fifth edition, revised, and the greater part rewritten Pp viii+383 (London Bradbury, Agnew and Co, Ltd, 1925) 20*s* net

IN this fifth edition of vol 3 of Schlich's "Manual" the number of pages is slightly less than in its predecessor Room has been found, however, for a considerable mass of new material, and for several new figures, by judicious compression and elimination, so that the work is brought up-to-date with the examination of new ideas and practice in forestry Those who peruse the several publications devoted to the science of forestry in England and in India are aware that the author has kept in touch with the latest developments, and here he brings to bear his keen faculty for criticism and for the correct appreciation of modern tendencies

All the features and main divisions of the previous edition are retained and improved Among the added subjects the British Forestry Commissioner's method of determining the volume of whole woods is described and criticised Sir William's own graph for indicating the mean forest per cent, first published by him in his pamphlet "Forestry in the United Kingdom" in 1904, is now included, as well as a reference to Mr W S Hiley's indicator graph, and among the modifications of the compartment system, Dr Eberhard's ingenious system of wedge fellings is discussed The controversy on the question of the rate and kind of interest to to be adopted in forestry has led to the inclusion of a paragraph explaining why the application of compound interest in forest finance is insisted upon

The volume is produced in the now familiar, neat, and handy form of the former editions, and should find place on the reference shelves of every scientific forester C E C F

A Survey of Physics a Collection of Lectures and Essays By Max Planck Translated by R Jones and D H Williams Pp vii+184 (London Methuen and Co, Ltd, 1925) 6*s* net

MESSRS Methuen are doing a real service to science by their publication of translations of foreign scientific works, but they are not always fortunate in their choice of books for translation It might have been thought

in a book with so attractive a title and by such an eminent scientific worker they had a real certainty. The book itself, however, somewhat disappointed our, perhaps unduly great, expectations. It is a collection of lectures and addresses, delivered on different occasions and at different times, mainly on the thesis that physics has now reached the stage when the attempt to form a mechanical picture of natural processes, which has engrossed the attention of the great physicists of the past, should be definitely abandoned, and we should satisfy our souls with the subtleties of thermodynamics and the search for an all-embracing formula. The author develops his thesis forcibly and ingeniously though, necessarily from the structure of the book, with some repetition, and the book should prove attractive to those interested in the philosophy of science. To the physicist the most interesting chapter is that in which the author sketches the road by which he arrived at the quantum theory. The translators have not always been happy in their rendering of the original. We, at least, had some little difficulty in recognising in "Thales von Milet" our old friend Thales of Miletus.

Joule and the Study of Energy. By Dr. Alex. Wood. (Classics of Scientific Method.) Pp. viii+88+8 plates. (London: G. Bell and Sons, Ltd., 1925.) 1*s.* 6*d.* net.

THIS excellent little volume could be read not only with profit but also with pleasure by all students of physics from the school-boy stage upward. There is no better way of appreciating the meaning and value of a scientific principle than a study of the ways in which it was evolved, and no better way of gaining a real understanding of scientific method than a study of the work of one of the great pioneers of science. In something under ninety pages, Dr. Wood succeeds in giving a clear and adequate outline of the gradual growth of the conception of energy, and a lucid account of the work of Joule on the mechanical equivalent of heat, illustrated by ample quotations from Joule's papers. At the same time, he finds room for those humanising touches of anecdote and biography which give life and colour to a work of this kind, and the numerous well-chosen illustrations add still further to the interest.

Dr. Wood has a high reputation as a lecturer, and he writes as charmingly as he speaks. Students of physics should certainly read and enjoy the book, but so clear is the exposition that those who, without being students of physics, are interested in scientific thought and method, could read it, we believe, with almost equal pleasure and interest. The editor of the series is to be congratulated on having persuaded Dr. Wood to write this book (we wish he had allowed him to write the general introduction also), and the publishers on producing it in such an attractive form and at so reasonable a price.

Smoke: a Study of Town Air. By Prof. Julius B. Cohen and Dr. Arthur G. Ruston. New enlarged edition. Pp. xii+108+15 plates. (London: Edward Arnold and Co., 1925.) 8*s.* 6*d.* net.

THE second edition of Prof. Cohen's and Dr. Ruston's book on "Smoke" is modelled closely upon the first. It has, however, some important additions on the effect of smoke on vegetation, and a new section has been added—"The Plant as an Index of Smoke Pollution." There is much useful information on the nature, quantity, and effect of soot, based mainly upon Prof. Cohen's own observations made in Leeds and its environs some years ago.

The chapter on "Town Fog" can scarcely be taken as setting forth the latest knowledge on the subject. For example, in describing the initial stages of condensation to form particles of mist or fog, p. 66, the vital distinction between the influence of ordinary dust and of hygroscopic salts is neglected, and ordinary dust is credited with an effect on condensation which it does not possess. Similarly, Aitken's "dust" counter is now known to take cognisance of hygroscopic nuclei only, neglecting ordinary dust. Yet this fact is not brought out when it is compared with the Owens' dust counter; the latter is incorrectly described as a modification of Aitken's, although based on a different principle and counting different particles. Again, the conception of a town fog as formed by condensation on "every little floating particle of dust" is not in accordance with the present state of our knowledge.

There is a little obscurity in the phraseology in plan (p. 27), but, on the whole, the book is a welcome contribution to the study of the air of our cities, the need for purifying which is becoming more apparent as such investigations lay bare the far-reaching ramifications of the smoke evil.

The Ao Naga Tribe of Assam: a Study in Ethnology and Sociology. By Prof. William Carlson Smith. (Published by direction of the Government of Assam.) Pp. xxvii+244+8 plates. (London: Macmillan and Co., Ltd., 1925.) 21*s.* net.

THE Aos, the people studied in this latest addition to the excellent series of monographs published by the Government of Assam, occupy the country lying between the Lhota and Sema Nagas on the south, and the various Naga tribes, collectively known by the Aos as "Miri," in what is mainly independent territory on the north. The Aos are composed of two racial groups, the Mongsen and the Chongli, which Mr. J. H. Hutton in his interesting introductory analysis suggests may have fused comparatively recently, the Mongsen representing a pre-Ao population. The author modestly does not claim for his book that it is any more than an introduction to the study of the people. He has covered a wide field in his account of the culture, social organisation, and religion and magical beliefs of the people, but not in that intensive manner which we have become accustomed to look for in this series. What is, perhaps, the most valuable part of the book, especially from the practical point of view of the future of the people, is the final chapter recording the changes in their culture which have been brought about by contact with outside, and especially European, influences. It is both a guide and a warning.

Nutrition de la plante. 4: *Cycle de l'azote.* Par Marin Molliard. (Encyclopédie scientifique: Bibliothèque de Physiologie et de Pathologie vegetales.) Pp. xv+319. (Paris: Gaston Doin, 1925.) 15 francs.

A SUBJECT which has attracted the attention of botanist, chemist, and bacteriologist alike is bound to be unwieldy and its literature difficult to survey in a book of three hundred pages. Especially is this the case

when, being part of a scientific encyclopædia, it must presumably be intelligible to those whose general scientific knowledge is only limited From this point of view, the book is well written, and the author, while necessarily introducing a good deal of text-book matter —as in Chap 1, which deals largely with tests and properties of various nitrogen containing compounds—has yet found space enough to make reference to more than two hundred original papers These have been well surveyed, and, in most cases, actual experimental numbers are given The various stages of the cycle are worked out somewhat on monograph lines in Chaps ii-v under the self-explanatory headings of nutrition, digestion, and transformation The sixth and last chapter is devoted to the *betes noires*, or those nitrogen containing bodies which do not find a definite place in the cycle The conflicting data and opinions of various authors are given, and the reader advisedly left to form his own A complete bibliography concludes a very readable and useful book E R

The Lilies of Eastern Asia a Monograph By Ernest H Wilson Pp xiv+110+17 plates (London Dulau and Co, Ltd, 1925) 25*s* net

It is not often that a writer on plants has the advantage of having had experience of seeing them in their native habitats, of cultivating them, and of studying them from herbarium material Mr Wilson is fortunate in having combined these, and shows in his introduction what good use he has made of his opportunities, so as to arrive at an estimate of the value of the various characters for taxonomic purposes He has made three journeys through those parts of eastern Asia which may be regarded as the headquarters of lilies, and has also studied the material preserved in the chief herbaria of the world The result has been the production of a volume containing detailed descriptions of the species and varieties, references to literature and synonymy, indication of habitat and notes on their cultivation, together with seventeen plates, of which several are reproductions of photographs taken by the author, of the plants in their native habitats The book will be of great assistance to students of lilies, and gives references to the scattered literature which has accumulated since the publication in 1880 of Elwes' "Monograph of the Genus Lilium"

C H W

Wireless Valve Transmitters the Design and Operation of small Power Apparatus By W James Pp viii + 271 + 8 plates (London Iliffe and Sons, Ltd, 1924) 9*s* net

The aim of the author is to deal in turn with the various parts of a complete radio transmitting equipment so as to enable the amateur to set up and operate his own transmitter A great deal of interesting and instructive work can be carried out by a "non-radiating" aerial, and certainly this type should be used by the beginner The circuit arrangements described are either standard practice or of proved practical utility The author's diagrams make his descriptions easy to follow Those whose experiments are carried out mainly by trial and error will do well to read this book Amateurs have recently had many successes to their credit, and they deserve every encouragement Rigorous mathematicians would not allow some of the proofs given in the book For example it is stated (p 7) that the skin effect is greater the larger the cross-section (S), the higher the frequency (f), and the better the permeability (μ) It is less for conductors with a high specific resistance (ρ) "Thus" the skin effect is proportional to $S\mu f/\rho$ It is conceivable that some readers might think that this was a proof

Choosing your Life Work By William Rosengarten Second edition Pp xxii+323 (New York McGraw-Hill Book Co, Inc, London McGraw-Hill Publishing Co, Ltd, 1924) 12*s* 6*d* net

This book sets out with the aim of helping a young boy to choose a career According to the author, psychological tests are so new and uncertain that for practical purposes they are almost as untrustworthy as phrenology and physiognomy Therefore the youthful aspirant for a career is recommended to analyse himself according to the *questionnaire* appended and then to turn to the various occupations and select according to his fitness A chapter is devoted to each of the common occupations, and the requirements, emoluments, and drawbacks to each are described It is distressing to learn that the telegraphist, although he fulfils a very important function, is unlikely to win high financial reward As a handbook to various trades, the book may be useful, its style is verbose and the information it gives would not have been impaired by judicious compression The blend of moral "uplift" and commercialism is not attractive to the English reader

The Dust Hazard in Industry By Dr William E Gibbs (Chemical Engineering Library Second Series) Pp 168 (London Ernest Benn, Ltd, 1925) 6*s* net

The subject dealt with in this book is one of great importance Industrial dust is frequently a source of danger, either to health, or to life and property by causing explosions Although much valuable information is available, the publications are scattered, and the author has performed a useful service in collecting and arranging the material in a readable form Particular attention is paid to dust explosions, on which much useful information has been obtained at the Home Office Experimental Station at Eskmeals American results, of great value, have also been fully considered, and the book is authoritative Some of the information will be of interest to medical men as well as to chemical engineers The name of the chief authority on explosions, Prof H B Dixon, does not appear in the book, although many of his results are quoted

Mechanical Mixing Machinery By Leonard Carpenter (Chemical Engineering Library, Second Series) Pp 138 (London Ernest Benn, Ltd, 1925) 6*s* net

Although this book deals with dry mixing, it overlaps in parts the volume on the same subject by Mr Seymour in the same series It is not altogether clear why the publishers should have thought it necessary to have had two volumes dealing with the same subject in the same series, but the two books will no doubt appeal to different classes of readers The treatment is practical, and the book is well illustrated

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

The Ionisation Potential of Ionised Manganese

IN his paper on the manganese spectrum (Phil. Trans. Roy. Soc., vol. 223 A, p. 127) Catalan gives some triplets and multiplets of the spectrum Mn II, and suggests identifications of some of them. I have recently made an attempt to estimate terms from some of these lines; two independent methods agree within the estimated limits of error, and it seems that it is possible thereby to estimate the ionisation potential with an error probably less than half a volt.

Catalan (*loc. cit.*) suggests that the enhanced triplet λλ 2576, 2594, 2606 and multiplet consisting of three triplets near λλ 2428, 2438, 2453 are the first principal and first diffuse triplets of Mn II. Back (*Zeit. f. Phys.*, vol. 15, pp. 238-40) has confirmed the first of these identifications by the Zeeman effect, and has shown that the terms belong to a septet system similar to the Cr I septets (for which see Gieseler and Grotian, *Zeit. f. Phys.*, vol. 22, p. 228), and he agrees with Catalan's identification of the diffuse multiplet.

Further, Catalan states that the lines λλ 2576, 2594, 2606 forming the first principal triplet are the most persistent of the enhanced lines of Mn, so they are probably the "ultimate lines" in Russell's sense (*Astrophys. Journ.* vol. 61, p. 223), and if so, the septet $1s$ term corresponds to the normal state of the atom.

Now Hund (*Zeit. f. Phys.*, in press) has shown reason to believe that the distribution of electrons in the Cr and Mn^+ atoms in their normal states is the same (5 electrons in 3_3 orbits and 1 in a 4_1 orbit, the inner n_k sub-groups being complete; this is the only case in the iron group in which the normal state of a neutral atom has the same distribution of electrons as the normal state of the ionised atom in the previous place in the periodic table), so the $1s$ terms of the Cr I and Mn II septets are really corresponding terms. Also for Cr I the zero of term value corresponds to the ionisation of the atom by removal of the 4_1 orbit, and if we take a corresponding zero for Mn II it seems likely that quantitative relations between the septet terms of the two spectra can validly be applied.

From the principal triplet alone it is possible to estimate term values in two ways. The quantum defect q for the n_k term, wave number ν, of an atom core charge C being defined by $\nu/R = C^2/(n-q)^2$ as usual, the two estimates are as follows:

(1) For Cr I septets, the s terms belong to a sequence of the Rydberg type, so they can be associated with different orbits of a single series electron, and the concept of a quantum defect is significant; and the first p term (Gieseler and Grotian's 4_2) looks like the first member of a Rydberg sequence. The difference of quantum defect between the first s term and the smallest member of the first p term is 0.46; judging from the behaviour of the similar difference in other spectra, it seems probable that its value for Mn II septets will lie between the limits 0.35 ± 0.02. Using the first principal triplet above mentioned, this gives $1s(4_1) = 119{,}000 \pm 4000$.

(2) The triplet separation for the p term of Cr I fits the Landé formula (see *Zeit. f. Phys.*, vol. 25, p. 48) fairly well, so it may be expected that the relation between the separations for corresponding terms of Cr I and Mn II will be given by this formula. The best way of applying it is through Δq, the difference of quantum defect q between the extreme members of a multiple term. The value of Δq for the 4_2 term of Cr I septets is 0.00584; for the corresponding term of Mn II it would be expected to be about 0.0061. The value of $\Delta\nu$ is known from the separation of the first principal triplet, so the value of the term can be calculated. It leads to a value $1s = 116{,}000$, the limits of error being estimated at ± 5000.

The agreement of the two independent estimates, one from the position of a line of the triplet and the other from triplet separations, is most satisfactory; it seems likely that the $1s$ term of the Mn II septet system lies within the limits $118{,}000 \pm 3000$. The ionisation potential corresponding to the removal of the 4_1 electron is then 14.5 ± 0.4 volts.

It seems possible that similar methods may be of use in providing approximate values of terms of other spectra of ionised atoms, of which only a few lines are known, if suitable lines can be identified.

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The Future of the British Patent Office

PATENT Law is a means to an end, and until the nature of the consideration which the patentee is to bring in in return for his monopoly has been clearly ascertained, it is idle to attempt to lay down what should or should not be the appropriate practice at the Patent Office. Now the object of British Patent Law has varied materially during the last three hundred years.

Coke, for example, is the chief authority for the construction of the Statute of Monopolies and this is his commentary: "The reason wherefore such a privilege is good in law, is because the inventor bringeth to and for the Commonwealth a new manufacture by his invention, cost and charges, and therefore it is reason that he should have a privilege for his reward" (Coke, 3 Inst. 181). Under the Stuart dynasty, the jurisdiction of letters patent was reserved to the Privy Council. This body administered the Statute of James in the sense of Coke's dictum. It insisted that the patentee should make good at the earliest opportunity and was always ready to revoke an unused patent in favour of a second applicant with better credentials; the latter became "the true and first inventor" under the Statute. About 1750, however, its jurisdiction was allowed to lapse, and patentees henceforward were compelled to seek their remedy in the Courts of Law. The latter being without recent precedents to guide them, interpreted the contract in the letters patent in the light of the specification clause, and in 1778 it became established law that the patent specification was the price of the monopoly.

This doctrine held the field until 1883, when the needle of patent law again began to show signs of instability. The Patents Act of that year contained certain inoperative compulsory licensing clauses, which were afterwards strengthened, but in 1919 the needle once more veered round with a swing to the Statute of Monopolies—the Act of 1919 laying down that "patents for new inventions are granted not only to encourage invention but to secure that new inventions shall, as far as possible, be worked on a commercial scale in the United Kingdom without undue delay, and further providing that a patent shall not be invalidated by the prior sale of the inventors' product if a patent has been applied for within six months of such sale."

Hence there are two basic principles of patent law, (*a*) that patents are granted in consideration of the disclosure of inventions, (*b*) that they are granted for the institution of new industries

Although both principles may fitly be recognised in a given system of patent law, they cannot be regarded as coequal For the type of administration appropriate to (*a*) not only differs from but also is even antagonistic to that which would naturally be evolved under (*b*) Under (*a*) there must be a highly elaborated machinery for the investigation of novelty, with the result that patents will be granted with relatively narrow claims, and that the capitalist be able to buy inventions cheaply for patents will possess little restraining power An official search, no doubt gives additional security, but the commercially valuable factor in a monopoly is its restraining power Hence, as a general rule, when security is at its highest the other factor will be "little, or none at all"

Trustworthy evidence of the commercial value of patents is not readily obtainable—for it is against the interest of patent officials, agents and owners alike publicly to depreciate their own services or properties The following communication however, was sent to the present writer in 1923 from a well-known scientific writer in Washington He writes "I have been wondering for some time whether the world s patent offices are not about to break down under their own weight Simple arithmetic shows that the possible permutations and combinations of known principles and kinds of matter are so numerous that their task is hopeless unless the definition of invention or originality is radically changed The U S Patent Office is already in a badly demoralised state and far behind with its applications, and its patents have for some years been recognised as worthless in themselves being essentially only tickets of admission to the courts of law" Corroborative evidence on this point will be found in my letter to NATURE, Nov 11, 1922, p 633 These are inside views of the effect of a universal search upon the selling value of patents

The writer of the articles in NATURE of July 25 and August 1 proposes a search through the 1759 periodicals taken in the Patent Office Library But what about the 24,028 registered in the recently published "World List of Scientific Periodicals"? His search is to be limited to suit the convenience and capacities of the examining staff Section 41 (1) of the Patents and Designs Act 1907 established the principle that 'what we don't know isn't knowledge" in order to round off the official 50-year search (see my letter as above) When I pointed this clause out to a legal authority, he said it was 'damned nonsense"—but it is proposed in the articles referred to above to extend the principle

The remedy is obvious An administrative search for novelty has long been an economic absurdity The direction in which reform should be sought, if the object of our patent law is to stimulate the growth of British industries, is in the relief of the patentee from the unduly high legal standard of novelty Sir John Dewrance in his presidential address before the Institution of Mechanical Engineers in 1923 supports this contention He writes It has always seemed to me to be unfair that documents should be evidence of anticipation evidence should be of prior use' This relief can of course, be granted to the patentee only upon proof of commercial working

Hence official search for novelty should be restricted to secure that concurrent British patents are not granted with overlapping claims With a simplified procedure and broader claims, which can be substantiated so soon as the patented process has been reduced to practice, capital will once more flow into native industries

Underlying the case presented in NATURE is the thesis that the public requires to be protected against the inventor My case is that the inventor should be wooed and if possible won to come over and help us, and for this purpose I would make the law clear and consistent and the official practice cheap and expeditious E WYNDHAM HULME

A Radio Method of Estimating the Height of the Conducting Layer

IN a recent note we have outlined a method of estimating the height of the conducting layer by means of radio waves (M A Tuve and G Breit, *Terr Mag*, vol 30 (1925), pp 15-16) Through the co-operation of the U S Naval Research Laboratory, Bellevue Anacostia, D C we have obtained definite indications of reflections such as would take place from the layer and some estimates of its height The method used consists in sending out interrupted high frequency wave-trains and observing the wave-form of the received signal Each wave train received manifests itself as a temporary rise in the detector current of the receiving set One particular wave-train at the transmitter gives rise to two received wave-trains at the receiver if a single reflection takes place One of these trains travels over the ground and the other by way of the layer Thus the detector current is forced to rise at two different times by the same wave-train from the transmitter and an oscillogram of the detector current shows two humps generally of unequal size

The transmitter was operated with a 500-cycle plate current supply so that a wave-train of 71 3 metres wave length was emitted during a part of each positive half of the cycle A succession of single humps is thus emitted (We have made sure of this by observing the wave form at the same time at the transmitting and the receiving stations) The receiving station was located 7 miles away from the transmitter in a general direction north, the Potomac River and the City of Washington being between the two stations We have observed the received wave-form visually and photographically Double and triple humps were observed on some days though practically single humps were observed on others Marked variations in the relative position and amplitude of the humps were observed during 10-minute observation periods The retardation of the secondary humps with respect to the primary is of the order of 1/1700 second, which corresponds to a retardation over a length of roughly 110 miles and a distance of the layer of the order of 50 miles Other humps correspond to 100 miles The origin of triple humps is not clear The possibilities of a wavy surface in the layer and successive reflections suggest themselves

Experiments on other wave-lengths with different receivers and transmitters and in different locations seem valuable We are hoping that such experiments will be performed by others as well as ourselves Some experiments at 600 metres were performed in co-operation with the Radio Corporation of America, the distances between the two stations being about 150 and 100 miles No definite indication of the presence of the layer was found in these cases

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Science and Intellectual Freedom

IN the issue of NATURE for July 18, p 103, it is stated " Our sole object in taking up the subject of the prohibition of the teaching of evolution in certain States of the United States, and in inviting opinions upon this action from a number of leading authorities, has been to afford support to our colleagues fighting for scientific truth and progress against dogma and stagnation We trust that the additional messages subjoined will give them the strength and courage they need to secure for them the position of intellectual freedom established in Great Britain many years ago, and existing unchallenged to-day "

It is possible to appreciate the good intentions of this patronage without admitting its need Not intending to bite the hand that feeds us, I still venture to express a doubt as to whether the strength and courage of American men of science in their efforts to attain the intellectual freedom established in Great Britain will be greatly forwarded by the series of little articles published in NATURE and by the editorial comments

Tennessee is the only State concerned, and it does not forbid the teaching of evolution, but only the teaching in tax-supported institutions of the derivation of man from a lower order of animals The law is unfortunate, and is opposed by general public sentiment as well as by men of science It should, however, be remembered that Tennessee also forbids the reading of the Bible in its public schools, it does not expect them to teach that the evolution of man is not true The control of teaching by legislation is unwise but no sensible teacher would want to lead children to question the religious convictions of their parents Intellectual freedom is also interfered with when a premier prescribes that the children of a nation must study Latin, thus leaving no time for the study of science

There is a larger proportion of " Fundamentalists " in every European nation than in the United States and also a larger proportion of educated people who profess, without believing, the thirty-nine articles and other inherited creeds Sir Joseph Larmor, the distinguished man of science who represented the University of Cambridge in Parliament, made it one of his chief pleas when he was first a candidate that he would support the maintenance of the control of the Church of England over tax-supported schools It is not surprising if a majority of the rural population of Tennessee hold the creed that Mr Gladstone defended and that Lord Balfour exploits in more sophisticated fashion They would scarcely follow the vagaries of Sir Oliver Lodge The only scientific man here who manifests an interest in such things was sent to us from the University of Oxford But perhaps it is undesirable to make international comparisons

J MCKEEN CATTELL

New York, July 30

On the Spectra of Neon and Argon in the Extreme Ultra-violet

AT the April meeting of the American Physical Society (see *Physical Review*, 25, 886, 1925) we reported the existence of a very strong pair of lines in the spectrum of neon at λλ 743 78 and 735 95, together with some ten other lines, all combinations with a fundamental $1p$ term in this spectrum We are glad to see that G Hertz (*Die Naturwissenschaften*, May 29) has independently found the same strong pair, and that their position agrees satisfactorily with our measures and with that obtained by him from resonance potential observations

It is perhaps worth while to note that the spectrum of argon contains a similar pair, at λλ 1048 28 and 1066 73 (±0 2), together with a number of other lines of shorter wave-length, which are probably components of a like pattern The strong pair fits exactly the resonance potential, 11 5 volts, found by Hertz Another observed pair corresponds to his value of 14 0 volts His third resonance potential, 13 0, seems not to correspond to any emission line, but the presence of unidentified impurity lines in our spectra makes it necessary to take further observations before giving final data

The complete argon spectrum is probably like that of neon The strong lines are therefore combinations of a fundamental $1p$ term with terms $1s_2$ and $1s_4$ The latter combine with other terms, as yet unknown, to produce several lines which are listed in tables of constant wave-number differences (*e g* Kayser, 'Handbuch" 7, p 26 where two of the columns refer to such combinations) More observations on the spectrum of argon are, however, needed before the structure of the spectrum can be worked out

In neon a curious fact has been noted The line at λ735 is normally stronger than that at λ743, it is in fact the strongest line in the whole spectrum When, however, a small quantity of neon is present as an impurity in helium the relative intensities of the lines of this pair reverse λ735 becoming the weaker of the two Our observations make it seem unlikely that this could be due to the presence of a sharp-edged absorption band in our helium One would therefore suppose that collisions between atoms of neon and of helium render the peculiar atomic state yielding the line λ735 less probable than is the case when the neon is alone Argon as an impurity in neon shows no such effect

THEODORE LYMAN
F A SAUNDERS

Jefferson Physical Laboratory
Harvard University, July 25

Lunar Periodicity in Obelia

IN Proc Roy Soc, vol 95, 1923, Mr H M Fox directed attention to a number of cases of " Lunar Periodicity in Reproduction " in marine organisms To these may be added the hydroid *Obelia geniculata* At first sight the periodicity is masked by the irregular breeding of colonies which are wave-worn or much eaten down by nudibranchs, but if attention is confined to healthy and perfect colonies, the lunar periodicity seems quite definite During 1924 several colonies on the piers were located and watched the best result was from a colony on Laminaria on Millport old pier, which was giving off medusæ during the ten-day periods beginning with the third week of the moon in July, August and September, and not at other times Other colonies gave definite results in two consecutive months, but were then attacked by nudibranchs or lost

More recently twelve colonies at Keppel were examined on July 28 (first moon quarter)—none of them had gonothecæ, one colony had minute axillary buds beginning to form gonothecæ, on August 5 (full moon August 4)—of fifteen colonies examined, eight were worn, frayed or eaten, the remaining seven were healthy and ripe, including small colonies of only five or six branches, probably three weeks old

Miss S M Marshall has confirmed these observations by noting occasional abundance of Obelia medusæ in the plankton about the third quarter of the moon Colonies which have been much eaten by nudibranchs may, if abundant food be present,

recover rapidly and reproduce at any time, to which is probably due the fact that this case of lunar periodicity has escaped observation.

RICHARD ELMHIRST.

Marine Biological Station,
Millport.

Magneton Numbers of Iron in some Complex Salts.

DR. L. C. JACKSON'S letter in NATURE of June 27, p. 981, points out the fact that an iron atom, known definitely to be ferrous, can have at least four distinct magnetic moments, namely, 26, 26.5, 27, and 27.5 when expressed in the magneton of Weiss. The purpose of this note is to present preliminary data tending to show that the magneton numbers for ferrous iron are not limited to 26-27.5, but can be 0 and 10 as well. Likewise, a ferric iron atom can have a magnetic moment corresponding to 0 and 10 magnetons in addition to the 29 magnetons usually obtained from measurements on simple paramagnetic salts. An example is included of an iron compound, the carbonyl, in which the iron certainly plays the part of a diamagnetic element.

The data appear in the table below. The mass susceptibilities for potassium ferricyanide, potassium ferrocyanide, and iron carbonyl are taken from a paper by Oxley (Proc. Camb. Phil. Soc. 1910–12, 16, 102), whose values have been recalculated since the susceptibility, k, of the reference substance, water, is now considered to be -7.19×10^{-7} rather than -7.5×10^{-7}. The other complex salts are formed by the substitution of the radicals NH_3, NO_2, etc., for one of the CN groups in either the ferricyanide or the ferrocyanide of sodium. One of them is the well-known sodium nitroprusside. The other seven were prepared by Dr. Baudisch of this Institute, who followed, in general, the methods described by Hofmann (*Annalen der Chemie*, 1900, 312, 1).

Iron	Complex Salt (solid state)	Susceptibility $K \times 10^7$ / gm.	Susceptibility, $K_m \times 10^7$ / gm. mol.	Net Susceptibility of Iron $K_i \times 10^7$ / gm. atom	Magneton Number: Observed		
					Weiss	Probable Real Value: Weiss	Probable Real Value: Bohr
Ferric	$K_3Fe(CN)_6$	+90.0	+29610	+30800	10.2	10	2
	$Na_3Fe(CN)_5NH_3+H_2O$	+95.3	+25500	+26500	9.5	10	2
	$Na_3Fe(CN)_5NO_2$	+87.3	+26300	+27170	9.6	10	2
	$Na_3Fe(CN)_5OH_2+H_2O$	+104	+27900	+28880	9.8	10	2
	$Na_2Fe(CN)_5NO+2H_2O$	−3.497	−1045	−43	—	0	0
Ferrous	$K_4Fe(CN)_6+3H_2O$	−4.07	−1720	+54	0.43	0	0
	$Na_3Fe(CN)_5NH_3+6H_2O$	−2.77	−1055	+680	1.5	0	0
	$Na_4Fe(CN)_5NO_2+H_2O$	−1.49	−508	+582	1.4	0	0
	$Na_5Fe(CN)_5SO_3+2H_2O$	−3.31	−1380	+99	0.58	0	0
	$Na_3Fe(CN)_5OH_2+H_2O$	+41.2	+12000	+13070	6.6	10	2
—	$Fe(CO)_5$ (liquid)	−3.84	−752	−540	—	—	—

The net susceptibilities pertaining to the gram atom of iron were obtained by allowing for the diamagnetic moment due to the atoms other than iron. For this purpose use was made of the diamagnetic constants listed by Pascal (*Revue generale des Sciences*, July 15, 1923). Since my measurements were made on the salts in the solid state, the Weiss formula for the magneton number

$$N = \frac{\sqrt{3RTK_i}}{1123.5}$$

is not directly applicable. But Weiss (*Jour. d. Phys.*, 1911, 1, 965, 5th ser.) has already calculated that iron in potassium ferricyanide has 10.41 magnetons by making use of Pascal's measurements on this salt in a dilute solution (*Ann. Chim. Phys.*, 1909, 16, 531, 8th ser.). Weiss's value 10.41 becomes 10.2 when revised on account of the newer susceptibility, $k = -7.19 \times 10^{-7}$, assigned to the water used as a standard. 10.2 was therefore adopted as the correct magneton number for potassium ferricyanide, and all of the others were calculated by taking the magneton number to be proportional to the square root of the net susceptibility.

We note at once that the magneton numbers group themselves around ten and, very probably, zero. There is no doubt as to the ferric salts, provided that we accept the value of 10 magnetons for potassium ferricyanide. The fact that the ferrous diamagnetic salts give magneton numbers up to 1.5 may be due to the presence of small amounts of paramagnetic impurities or to uncertainties about the diamagnetic constants used in calculating the net susceptibilities. Both of these factors are important in dealing with diamagnetic substances. According to the table, the last ferrous salt $Na_3Fe(CN)_5OH_2 + H_2O$, does not yield 10 magnetons. 6.6 is the highest value yet observed. The salt is difficult to prepare and becomes more and more paramagnetic on repeated recrystallisation. At first it seemed to approach 5 Weiss magnetons, or one of Bohr's, as a limit. Since it passed 5 magnetons its upper limit is now believed to be 10. At any rate the magneton number of the iron in this salt is known to be greater than 6.6.

Still more interesting than this grouping of magneton numbers about zero and ten is the appearance of two inversions. Iron in most of the ferric salts has 10 magnetons, but in at least one ferric salt it has none. Similarly, the ferrous salts usually contain no magnetons, but in one of them we find at least 6.6 and very probably 10. We see then that the magnetic moment of iron is extremely variable, and that it is not uniquely defined by a statement of its valence.

Gerlach (*Ann. der Phys.* 1925, 76, 163) has recently observed that iron in the vapour state has no magnetic moment. This suggests that its paramagnetic properties in a salt either solid or dissolved, are due entirely to the distortion of its electron system by the neighbouring atoms with which it is combined, or by the water molecules surrounding the ion. Altogether there seem to be at least seven principal states in which the iron may exist on account of these external forces of a chemical nature. Putting it in another way, there are at least seven main configurations of the electron system known to us as the iron atom. They are ferric iron, giving 0, 10, and 29 magnetons, ferrous iron giving

10, and the group of 26 to 27·5 magnetons, and then there is the iron which is nearly as diamagnetic as Pascal (*Revue générale des Sciences*, July 15, 1923) has found bismuth to be in its compounds.

LARS A. WELO.

Rockefeller Institute for Medical Research,
New York, July 23.

MR. WELO's interesting letter directs attention to the fact that the iron atoms in various complex cyanides possess quite different magnetic properties from the iron atoms in simple ferrous or ferric salts. The existence of iron atoms which are either paramagnetic, but have a moment considerably smaller than that found in the simple salts, or even diamagnetic (zero magnetic moment) finds a parallel in the observation of Pascal that oxygen may function in organic compounds as a paramagnetic element with the "usual" moment, as paramagnetic with a lesser moment and also as diamagnetic.

The susceptibilities of a large number of complex co-ordination compounds of cobalt and nickel are known. It would be of considerable interest to carry out similar calculations to Mr. Welo's with these data also. Cobalt and nickel atoms with zero magnetic moment may be expected, but the interesting point would be the determination whether these elements exist in modifications analogous to Mr. Welo's iron with 10 magnetons.

It may be of interest to mention the non-magnetic films of nickel which have recently been described. Their existence has been ascribed elsewhere to a rearrangement in the electron configuration similar to that suggested by me in the letter referred to by Mr. Welo. By this rearrangement the electron configuration of the nickel atom becomes completely symmetrical and hence the atom possesses no magnetic moment.

A further study of data such as are given by Mr. Welo and those derived from the simple salts of the magnetic elements is likely to be of considerable interest in giving some evidence of the deformations or rearrangements of the electron orbits of an atom in a solid compound. The magnetic properties of the free undeformed atom may be inferred from spectroscopic data.

Two further points may be mentioned in connexion with Mr. Welo's letter. First, his method of calculation of the magneton numbers implicitly assumes that the various substances obey Curie's law $KT=C$. In general, however, paramagnetic substances obey the more general law, $K(T+\Delta)=C$, so that a single measurement at one temperature is not sufficient for the determination of the Curie constant C, from which the magneton numbers are calculated according to Weiss. Mr. Welo's numbers may, therefore, need a correction on this account. Further, it is scarcely permissible to calculate the Bohr magneton numbers merely by dividing the corresponding Weiss numbers by 5 since, though the Bohr magneton is essentially a quantum unit, no account is then taken of the spatial quantisation factor.

Secondly, it seems that there is a slight misunderstanding of the purpose of my letter already referred to. It is perfectly reasonable to expect that iron atoms in quite different modes of combination should possess different magnetic properties, but in the letter attention was directed to the fact that iron atoms in ferrous compounds may exist in different magnetic states in one and the same compound. Thus the four values of the magneton number there mentioned were obtained from observations on ferrous ammonium sulphate.

L. C. JACKSON.

The Band Spectra associated with Carbon.

HAVING read with great interest the two communications by Prof. Raymond T. Birge, published in NATURE of August 1, p. 170, and August 8, p. 207, I should like to direct attention to the fact that I gave in 1924 the description and wave-lengths of the band spectrum described a year later by Dr. R. C. Johnson as "A New Band System" in Proc. Roy. Soc. A, 108, 349, June 1925, and called "the new Johnson group" by Prof. Birge (NATURE, August 8, p. 207).

My first publication concerning these new bands appeared in *Comptes rendus*, 178, May 5, 1924, p. 1525, under the heading "Sur les spectres de la décharge thermionique dans l'oxyde de carbone. *Nouveau spectre de bandes*" (italics mine here). It was also published with a photographic reproduction of the bands in *L'Astronomie*, 38, Nov. 1924, 444, Fig. 236.

The thermoelectronic bulb filled with pure carbon monoxide at a pressure of about half a millimetre gives with intensity only the three double-double headed bands at λ4236, 3978, 3730, while the helium mixture of Dr. Johnson gives three additional bands. So far as I can judge with such a limited number of bands, it appears that the distribution of the intensities seems a high-temperature distribution with thermoelectronic bombardment, while it would be a low-temperature distribution in a helium mixture. Prof. Birge has rightly made the same remark for the comet-tail bands (NATURE, August 1, p. 171).

Since the publication of my above-mentioned papers, I have obtained the three bands with a great dispersion, and I will give later the analysis of their fine structure.

F. BALDET.

Observatoire de Meudon, August 12.

The Transport of Organic Foodstuffs in Plants.

FROM the ringing experiments of early times, it has reasonably been inferred that foodstuffs are translocated downwards by the phloem. But to complete the evidence it would be necessary to prove directly that the tissues external to the wood can translocate foodstuffs by themselves. Adequate experimental evidence for this has never been produced, and recently it has been maintained that downwards as well as upwards the foodstuffs must be translocated by the wood (Dixon, H. H., and Ball, N. G., NATURE, February 23, 1922, vol. 109, p. 236).

Evidence for translocation by the rind I have, however, now been able to obtain by rooting shoots of *Salix fragilis* in tap-water, and peeling off from below upwards strips of rind from 4 to 8 cm. long, each carrying a root. The strips remained connected with the shoots above. The roots on these strips grew at rates up to a centimetre a day, and nearly as fast as similar roots on intact parts of the same shoots. They continued to grow indefinitely. The foodstuffs for their growth must have been translocated from the shoot, for roots on short, completely isolated strips of rind grew only for a few millimetres and then stopped, showing that the local supply was insufficient. Since new wood did not begin to be regenerated for from four to eight days, the foodstuffs must have been translocated by the rind alone.

It should be mentioned that before the roots on the strips of rind could be got to grow, it was found necessary either to prevent the water surrounding the roots from touching the inner surfaces of the strips, or to keep this water sterile with one part in 120,000 of thymol.

It is hoped to continue the experiments next spring.

R. SNOW.

Magdalen College, Oxford.

The New Ideas in Meteorology [1]

By Dr G C Simpson, F R S

THE first quarter of the twentieth century will always be remarkable for the great advances made in science In our own particular branch the advance has probably been the most startling and has appealed very strongly to the popular imagination In mathematics we have had a little-known and even less-understood branch of pure mathematics applied to physical problems with results which have revolutionised our whole conception of the universe in which we live In astronomy we have had described to us an evolution of the heavenly bodies as real and as dominating as the evolution which the previous century revealed in the animal kingdom In physics the progress made has been most remarkable At the beginning of the century, it is true, we had been introduced to the electron, to Rontgen rays, and to radioactivity, Planck was also writing on the laws of radiation, but no one realised the powerful tools which these phenomena were going to put into the hands of physicists These tools have, however been used, and not least by our own countrymen, to dig deep into Nature's secrets, even into the atom itself, so that now we are able to visualise the component parts of an atom, which itself is a structure far removed from our powers of perception

Meteorology, although a child of applied mathematics and physics, has scarcely been touched by the epoch-making discoveries in the house of its parents The quantum has found no place in our theories of the mechanism of the atmosphere, a knowledge of the structure of the atom has not helped us to understand the physics of the air as we deal with it in meteorology, the relationship between mass and charge, the invariability of the velocity of light, four-dimensional space and all the other new conceptions which have been responsible for the advance of physics, have been of no help to meteorologists in their especial branch of science

The whole attention of physicists has been so dominated by these new ideas, and the vistas of unexplored country which they have opened out are so vast, that it is no wonder that physicists have had no interest in a domain in which their new tools could not be employed The consequence has been that meteorology has had little help from physicists and mathematicians as such, and has had to depend, at least in Britain, on the relatively small band of meteorologists in Government employ Let me say, however, that we are grateful for the help which we have received from physicists, especially from those who were brought into contact with meteorology during the War In spite of the fact that meteorology has not been able to make use of the recent discoveries in pure physics, there has been in the last twenty-five years as fundamental a revolution in our ideas of the atmosphere as has taken place in our ideas of electricity and matter Unless I am very much mistaken, however, these fundamental changes in our conception of the atmosphere, both as a whole and in its parts, are little known outside the small band of professional meteorologists I therefore welcome this opportunity of bringing them before the members of Section A of the British Association

The Thermal Stratification of the Atmosphere

The fact that the temperature of the air decreases as we ascend in the atmosphere has been known from time immemorial, but our real knowledge of the temperature of the free air dates only from 1898, when Teisserenc de Bort introduced his *ballons-sondes*, which carried self-recording instruments to heights in the atmosphere up to that time never attained and from which no information was then available

The initial success of Teisserenc de Bort in his epoch-making discovery of the stratosphere attracted great attention to his investigations His methods were introduced into other countries, and an intense investigation of the upper atmosphere, with an International Commission to guide and encourage it, was inaugurated In Britain, Mr W H Dines did Trojan service in the cause, and his observations and deductions are outstanding in the mass of data accumulated in many parts of the world Naturally the conditions over Europe and North America were investigated in the greatest detail, but every opportunity has been taken by meteorologists to obtain upper air data from all parts of the world In addition to the regular observations undertaken in most countries having an organised meteorological service, expeditions have gone out specially to investigate the upper atmosphere over the oceans and over tropical Africa, and nearly all recent polar expeditions have included this investigation amongst their scientific activities

There are, of course, large tracts of the earth's surface above which no observations have yet been made, but some, if only a few, observations have been made in all meteorologically important areas, including both polar regions It is on the results of these observations that we base our conception of the thermal structure of the atmosphere and meteorologists have attempted from them to generalise the conditions in all parts of the world The most important generalisation of this kind has been made by Sir Napier Shaw and published in the form of diagrams in his book, "The Air and its Ways"

Probably every one here is familiar with the main results of these investigations The atmosphere, which itself is an extremely thin film of air, is composed of two shells surrounding the earth In the lower of these shells, called the troposphere, the temperature decreases as one rises in the atmosphere, and the air is warmer over the equator than over the poles at corresponding heights In the upper shell, called the stratosphere, the temperature conditions are entirely different There is little or no change in temperature with height, and the horizontal change of temperature is reversed, the temperature at the same height in the stratosphere decreasing as one passes from the poles to the equator At the earth's surface the mean

[1] From the presidential address delivered at Southampton on August 28 before Section A (Mathematical and Physical Science) of the British Association

annual temperature near the equator is 27° C., and at the poles −23° C., *i.e.* the equator is 50° C. warmer than the poles. At twenty kilometres above the surface the temperature over the equator is −80° C., and over the poles −30° C., that is, the temperature difference between the equator and the poles is the same in amount at the surface and at a height of twenty kilometres, but in the former case it is the equator which is the warmer, while in the latter it is the polar regions—a truly remarkable reversal.

The surface of separation between the two shells, called by Sir Napier Shaw the "tropopause," is extremely sharp. There is no region of transition. The stratosphere sits on the troposphere like a layer of oil on a layer of water. The boundary is, however, not horizontal, and therefore not exactly concentric with the earth's surface, being higher at the equator than at the pole. In other words, the lower atmospheric shell, the troposphere, is thicker at the equator than at the poles. At the equator it is nearly twenty kilometres thick, while at the poles it thins down to a layer less than six kilometres thick in the summer and less than four in the winter.

I have already said that in the troposphere the temperature decreases as one ascends. The magnitude of this decrease varies from place to place and from time to time, but one remarkable result has come out of the investigation, and that is that the average decrease is practically the same in all parts of the world. Near the ground the conditions are complicated; here the rate of decrease is largely affected by such factors as the kind of surface, whether land or water, the time of day and the time of year. If we omit for this reason the two lower kilometres of the atmosphere, we are able to state that the rate of decrease of temperature with height, to which I shall refer as the "lapse rate," is the same in all parts of the world, from the equator to the poles. The lapse rate is not the same at all heights, but increases regularly as one ascends. Between two and four kilometres above sea-level the rate of decrease is 5.6° C. for each kilometre of ascent; the rate is greater at greater heights, until towards the top of the troposphere, say between six and eight kilometres, the rate is 7.1° C. per kilometre.

The importance of these results lies in the bearing they have on the possibility of vertical motion in the atmosphere. Whether air will rise or fall as the result of differences of temperature depends not only on an initial difference of temperature but also on the lapse rate in the surrounding atmosphere. When dry air rises its temperature falls on account of adiabatic expansion 10° C. for each kilometre of ascent. From the observed values of the lapse rate given above, it will be seen that if a mass of air is as much as 10° C. warmer than its surroundings it cannot rise much more than two kilometres before it has no buoyancy left. The question of ascending and descending air is, however, very complicated on account of the condensation of the water vapour carried with it. The vertical motion of the atmosphere cannot be determined simply from consideration of the lapse rate of temperature in the atmosphere. We have also to take into account the pressure and vapour content of the moving air. This can best be done by considerations of entropy.

Sir Napier Shaw has prepared diagrams showing the entropy throughout the normal atmosphere. These show surfaces of constant entropy which are nearly horizontal, but they slope upwards from the equator to the poles, especially in the lower layers. If these surfaces could be made visible, we should see a series of layers lying one above the other like the strata in a geological specimen of stratified rock.

In all movements of the air in which heat is neither added nor extracted—for example, by condensation or radiation—it must travel along an isentropic surface. Even if condensation takes place, the amount of heat added is usually so small that the air can only move to a neighbouring isentropic surface slightly higher in the atmosphere. These isentropic surfaces act like physical restraints to the air, tending to prevent its moving in any but an almost horizontal direction. The effect is almost exactly as though the atmosphere were definitely stratified in nearly horizontal planes, so that all motion of the air must take place along the strata in which it started.

This is what I mean by the thermal stratification of the atmosphere, and it is a new idea in meteorology, for it rules out ascending and descending currents as a direct consequence of the normal temperature distribution in the atmosphere. That ascending currents do occur and play a large part in atmospheric processes is, however, a matter of both observation and inference. We can actually see them taking place whenever we observe well-developed cumulus clouds, and we infer them from the large amounts of precipitation which we measure, for appreciable precipitation can only be accounted for on the assumption that air is rising in the atmosphere and cooling by adiabatic expansion. These ascending currents are possible in the stratified atmosphere only if the air taking part in them receives sufficient heat on its ascent to raise its entropy at least to that of the surrounding atmosphere at each level. Heat is supplied by condensation of water vapour, but normally air does not hold sufficient water vapour, even when saturated, to supply the requisite heat, and so cannot pierce the normal stratification. It sometimes happens, however, that the stratification is less pronounced than at other times. The greater the lapse rate the less the stratification, and by increasing the lapse rate sufficiently the stratification can be reduced to such an extent that there is sufficient water vapour to supply the heat required. When this occurs the atmosphere becomes unstable to saturated air and ascending currents take place, generally with considerable violence.

Such conditions give rise to thunder-storms, which occur, as is well known, only when the lapse rate has been abnormally increased, generally by the heating of the surface layers faster than the layers higher in the atmosphere. Also in equatorial regions over the ocean, where the air is very hot and also very humid, there may be sufficient water vapour in the air for it to rise through the normal stratification. This is the origin of the squalls and heavy rain in the Doldrums. From this it will be seen that the ascent of air through its environment is not a normal phenomenon, but does occasionally occur in special circumstances.

The descent of air is an entirely different matter, for there is no process which extracts heat from a

descending current equivalent to the process of condensation which supplies heat to an ascending current. Yet air cannot descend through the stratification without the necessary heat being extracted. On the other hand, we do know that air descends, for the air which goes up in the ascending currents, or rather an equivalent amount, must come down somewhere. The solution of the problem is that air practically never descends through its environment, but comes down by the gradual subsidence of a whole column. This is generally brought about by the air at the bottom of the column spreading under the surrounding air and so lowering the air above in a way to be described in greater detail later.

If now we consider the undisturbed atmosphere in different parts of the world, we find that each has its own stratification, which is mainly determined by the local radiation. At the equator the stratification is not so close as at the poles, and equivalent strata are higher in the atmosphere the farther we move from the equator. If a large mass of air is transported as a whole without gain or loss of heat, no change in entropy occurs, and therefore it retains its original stratification. It is therefore clear that if masses of polar and tropical air are brought together the strata will not fit. The process is something like removing two geological specimens from different parts of a stratified rock and then placing them side by side. We can recognise the surface where the two masses meet by the discontinuity in the strata; in geology such a surface of discontinuity is called a fault. We shall consider later the consequence of bringing together masses of air of different origin in this way, and it will be shown that they interact like separate fluids, but throughout the resulting motion they retain their stratification, although this stratification becomes modified and distorted.

This idea of the stratification of the atmosphere which has caused us to recognise that ascending and descending currents are relatively rare occurrences raises new problems as to how the solar energy is converted into the kinetic energy of winds. This leads me to the second subject of this address.

THE MECHANISM OF THE ATMOSPHERIC HEAT ENGINE

Brunt has calculated from considerations of wind and atmospheric friction that 25×10^{11} kilowatts of energy are required to maintain the motion of the atmosphere. It is generally agreed that this energy is derived from the solar radiation which falls on the earth, the atmosphere itself acting as a gigantic heat engine to convert the solar energy into the kinetic energy of the winds. How the atmospheric heat engine works is the problem which we are now to discuss.

Until quite recently this problem seemed to present no difficulty. All atmospheric motion was referred in one form or another to the ascent of warm air through cold air and the descent of cold air through warm air. The so-called general circulation of the atmosphere was considered to be the direct consequence of the ascent of warm air at the equator and the descent of cold air at the poles, there being a permanent circulation from the equator to the poles in the upper atmosphere, with a return flow in the surface or middle layers. Similarly cyclones were considered to form in regions where the air is warmer than the surrounding air with a consequent upward motion of the warm air through its colder environment. The anticyclone, on the other hand, was considered to be a region of cold descending air. Thus cyclone and anticyclone were regions of ascent of warm and descent of cold air respectively.

I have already shown, however, that the thermal stratification of the atmosphere, except in the Doldrums and occasionally in other regions, is prohibitive of such ascending and descending currents. Further observations have shown that there is no direct flow of air from the equator to the poles in the upper atmosphere, and measurements of temperature in cyclones and anticyclones have shown that the former are not warm and the latter are not cold.

Although the old ideas were wrong in detail, they were, of course, right in principle, for the potential energy inherent in masses of air at different temperatures must be the origin of the kinetic energy of the winds, the difference in temperature between the equator and the poles being responsible for the general circulation of the atmosphere, and the difference in temperature between neighbouring masses of air for the energy of cyclones and anticyclones. The only question is, how does the transfer from potential to kinetic energy take place?

The solution of the problem was given by Margules in a series of papers, commencing in 1903, in which he investigated the energy developed in storms. Margules' work leads to an entirely new idea as to the method by which solar energy is converted into the kinetic energy of atmospheric motion. Instead of warm air rising vertically like the warm gases in a chimney, drawing air in at the bottom and delivering it at the top, we see two bodies of air, one warm and the other cold, brought side by side, then the cold mass slowly subsiding and pushing its way as a wedge of cold air under the warm air, which is partly raised and partly drawn in above to replace the cold subsiding air. In the process the centre of gravity of the whole moving mass is gradually lowered, so providing the energy for the motion which we recognise as winds.

The essential difference between the new and the old idea is that the two masses of air, in which the difference of temperature is the cause of the motion, never mix. We start with the two bodies of air side by side, with a surface of sharp discontinuity between them. In each body there is a different stratification of isentropic surfaces. In the warm body of air the corresponding isentropic layers are all lower than in the cold body of air. As the cold mass subsides its isentropic layers are lowered, while as the warm air is raised its isentropic layers are raised with it; but the surface of discontinuity between them, which I have previously likened to a geological fault, is a sliding surface, and no air crosses it. The sliding motion does not cease until either the corresponding isentropic layers on the two sides have joined up across the surface, which then ceases to be a surface of discontinuity, or until all the warm air has been raised above the cold air and the surface of discontinuity becomes a horizontal plane. The two masses are then in equilibrium without any mixing having taken place.

SURFACES OF DISCONTINUITY

The process which I have just described would take place very rapidly on a stationary earth, and in a short time the surface of discontinuity would disappear in the manner described or appear as a horizontal surface with all the cold air underneath and all the warm air above But in the atmosphere we find inclined surfaces of discontinuity persisting for days together and others which are apparently permanent This arises from the effect of the rotation of the earth, which we have so far neglected, but which introduces new forces when air is in motion

A mathematical investigation of the conditions governing the air motion at surfaces of discontinuity has shown that, on a rotating earth, the tendency of cold air to pass under warm air can be completely counterbalanced by forces due to the earth's rotation if the air on the two sides of the surface has suitable relative velocities

We owe the mathematical investigation of this problem chiefly to Helmholtz, Margules, V Bjerknes, and Exner

Two bodies of air at different temperatures will remain in equilibrium side by side if suitable motion parallel to the boundary is given to the air on each side The angle which the surface of discontinuity makes with the horizontal depends on three factors, namely, the latitude and the difference in temperature and relative motion of the warm and cold currents Given steady motion, these three factors adjust themselves in a perfectly definite way, with the cold air lying as a rule in the acute angle which the boundary makes with the horizon

V Bjerknes considers that there are three great permanent surfaces of discontinuity of this kind in the atmosphere, and that the slope of the surface in each is in accordance with the discontinuities of the wind and density observed on the two sides Taking these in turn, the first is the great surface of discontinuity between the troposphere and the stratosphere The second surface of discontinuity is between the trade winds and the anti-trade winds above them Bjerknes' third surface of discontinuity, which has received the name of the "polar front" is a very important one in modern meteorological theory On the whole there is very little air motion in polar regions, and the cap of air over each pole is losing heat by radiation and so tending to subside and flow away from the pole As the air from the polar cap flows radially outwards it is deflected to the west on account of the earth's rotation On the other hand, in middle latitudes, from near latitude 30° to the polar circle, the air is moving in an almost unbroken stream from west to east Relative to the air in the polar cap this air is very warm We therefore have a cold cap of westerly-moving air embedded in a warmer mass of air moving towards the east, and between the two there must be a pronounced surface of discontinuity In such conditions the surface should slope upwards toward the pole V Bjerknes considers that there are such surfaces of discontinuity associated with each pole and that they are very stable These "polar fronts" play a large part, as we shall see later, in Bjerknes' theory of the formation of cyclones

But these are not the only surfaces of discontinuity which play a very real part in the physics of the atmosphere While the three surfaces just described are of a more or less permanent nature, we now recognise a constant succession of temporary surfaces of discontinuity which form and pass away in our own latitudes Their presence is revealed in many ways On the synoptic charts lines can be drawn which divide regions in which the conditions at the surface as regards temperature, humidity, and wind velocities are entirely different These lines are simply the intersection at the earth's surface of the surface of discontinuity between two bodies of air

THE ORIGIN AND STRUCTURE OF CYCLONES

The old idea of a cyclone was tersely expressed by Sir Oliver Lodge, in a letter to the *Times* last year, as follows "A cylindrical vortex with its axis nearly vertical, rolling along at a rate conjecturally dependent partly on the tilt and with an axial uprush of air to fill up a central depression, which depression, nevertheless, was maintained and might be intensified by the whirl, the energy being derived from the condensation of vapour" If this were the true mechanism of a cyclone we should expect to find considerable symmetry around the axis The air would move in a continuous stream circulating around the centre but always approaching it, in other words, the stream lines would be continuous spirals There would also be little difference of temperature in the different parts of the cyclone, for the same air current would pass successively through all parts In reality the conditions are entirely different When stream lines are drawn by the aid of the wind arrows on synoptic charts it is impossible to connect them so that they circulate all round the depression, we find, on the contrary, that they are discontinuous, the stream lines in certain parts meeting the stream lines in other parts almost at right angles Also we find large discontinuities in the temperature, each set of stream lines having its own temperature Further, we find that the areas of rainfall are not confined to the central regions, but are broad bands radiating from the centre like spokes in a wheel, showing that the ascending air is not taking place mainly in the central region

As the result of recent work we now recognise a structure in a cyclone which was unknown a few years ago We owe this new knowledge largely to the work of J Bjerknes and his assistants in the Bergen Geophysical Institute

We are being forced more and more to recognise in cyclonic depressions the meeting-place of polar and equatorial air Each body of air is stable to vertical currents within itself, but where the two masses meet readjustment is necessary, the surfaces of discontinuity tend to set themselves at the angle necessary for stability under the existing condition of velocity and temperature This involves the bodily raising of the warm air over the cold air and a general sinking and spreading out of the cold air The energy for the process is derived from the conversion of potential energy into kinetic energy, as the centre of gravity of the air as a whole is slowly lowered during the readjustment of the air masses The energy derived from the condensation of water vapour is a very insignificant part of the energy developed in a cyclonic depression

It must be admitted that we are still far from a complete understanding of the mechanism of cyclonic depression, on the other hand, we now know some features which are common to all depressions, and we have a much clearer idea of the source of the energy and the conditions necessary to their production We have to imagine that in polar and tropical regions the air is relatively stagnant, and so has an opportunity to reach the state of thermal equilibrium appropriate to those regions As already stated, the atmosphere is only a thin film, and we picture large areas or slabs of this film breaking away from their proper locality and moving into middle latitudes Apparently the detached films move as a whole, at least to a considerable distance within the stratosphere When two such portions of the atmospheric film come into juxtaposition they are not in equilibrium relative to one another, and readjustment must take place The surface of contact remains more or less intact, but the cold air tends to sink and undercut the warm air, while the warm air slides up the surface of discontinuity The whole motion takes place on the revolving surface of the earth, and the forces called into play by this revolution result in the air movement taking place in what appears to be a great vortex The energy of the winds is derived mainly from the readjustment of the centre of gravity of the air mass considered as a whole, although the latent heat of condensation provides some additional energy by supplying heat to the warmer air as it ascends the slope of the surface of discontinuity It will be admitted, I think, that this is a radically new idea regarding the mechanism of a cyclone

All that I have said so far refers to the cyclonic depressions of middle latitudes As to whether the mechanism of tropical cyclones is the same or whether we have here something more of the nature of the process described by Sir Oliver Lodge, meteorologists are not yet agreed We need more observations, especially of the conditions in the upper air over tropical cyclones, before this question can be decided At present we must leave it an open question

These new ideas have had a far-reaching effect on the practical applications of meteorology especially in the domain of weather forecasting The old method of weather forecasting was mainly empirical and based on the work of Abercrombie Abercrombie had sketched the distribution of weather about centres of high and low pressures and forecasting was based on the determination of the movement of these pressure distributions when they appeared on the weather chart, the assumption being made that as the pressure system passed over a place the normal sequence of weather would be experienced

Now the forecaster has much more knowledge of what I may call the anatomy of a depression The pressure distribution is of course still the main factor, but the forecaster searches his chart for indications of the surfaces of discontinuity, and examines the characteristics of the air masses to see whether they are of polar or equatorial origin In this way he is able to determine the structure of the cyclone and whether it is developing or dying Having determined where the surfaces of discontinuity are situated, he is able to say where rain may be expected, and he knows what weather changes will accompany the passage of each surface of discontinuity as it moves over the surface of the land He is aided in this by observations taken in the upper atmosphere by means of pilot balloons and aeroplanes fitted out with meteorological instruments

This has all resulted in greater confidence in the forecasts made, a confidence which is frequently justified by remarkably accurate forecasts Unfortunately, the processes which take place in the atmosphere are extremely complicated, and perfect forecasts are still far from being attained The progress made, however, is very encouraging, and, what is still more important, the paths along which further investigation must be made are clearly defined Many more observations of the upper air are necessary, many more theoretical investigations have to be made in the quiet of the study and there is room for many more experiments in the laboratory

Dispersal of Butterflies and other Insects

By E P FELT, State Entomologist of New York

A 2000-mile air trip appears almost impossible for an ordinary butterfly It is still something of a feat for an airplane Many insects are perfectly at home in the air, fly freely here and there, and are usually believed to flit from flower to flower or from one near-by locality to another Rarely do we think of their travelling considerable distances, and under ordinary conditions it is very difficult, if not well-nigh impossible, to establish the fact that long trips may be made by individual insects There is a romance about these journeys as well as a practical aspect The facts are not difficult to understand, and it should be comparatively easy for readers to arrive at satisfactory conclusions

The "Monarch" butterfly (*Danaida plexippus* L) is one of the commonest and most noteworthy insect travellers Its large size and tawny colour with black and white markings make it comparatively easy to recognise even at some distance This is the very common "milk-weed" butterfly of the northern United States and southern Canada, the insect which occasionally attracts notice because of the immense swarms which appear in early autumn, apparently southward bound The butterfly, although so common in the north temperate latitudes, is unable to survive our winters north of the sub-tropical portions of the Southern States Consequently, the annual reappearance of this insect proves a considerable northward movement each year, though it does not establish the fact that the entire journey from Florida nearly to the Arctic Circle is necessarily accomplished by individuals It may be the successive efforts of several generations working northward with the advance of warm weather

A similar northward flight is known for the cosmopolitan "Painted Lady" (*Pyrameis cardui* L) in

Europe. The butterflies cross the Mediterranean Sea, and in the opinion of Mr. C. B. Williams originate south of the north coast of Africa, since they have been seen entering Algeria from the south and have been observed crossing the Nile Valley near Cairo in thousands coming from the south-eastern desert. He believes that all Europe north of a line through the middle of France and South Germany or Switzerland depends entirely for its Painted Lady butterflies upon African areas south of the great desert, some finding their way to northern Scotland, Scandinavia, the Shetland and Faroe Islands, and even distant Iceland.

The above cannot explain the presence of the Monarch butterfly in the Hawaiian Islands, areas 2000 miles from the American continents, where the insect was not known prior to the establishment of its food-plant, a milkweed (*Asclepias curassavica* L.), in the islands about 1850. At one time it was thought that this butterfly may have made its way to the mid-Pacific with the aid of shipping, in spite of the fact that the habits of the insect are such as to make it improbable that it could be carried with its food-plant in its early stages, or be content to remain upon a ship during an entire voyage. Furthermore, shortly thereafter this butterfly became generally established in a number of other Pacific islands, and if commercial agencies were the carriers, they certainly were very accommodating. The observations of Commander Walker of the British Navy indicate the habitual presence of these butterflies at sea among the Pacific islands and many miles from land.[1]

The above facts are not conclusive as to the ability of the Monarch butterfly to negotiate safely a 2000-mile journey over the Pacific Ocean, and yet they are very suggestive. There is a remote possibility that some unusually favourable condition may have made it possible for this insect to establish itself in the mid Pacific. It happens, however, that three other large butterflies, the Red Admiral (*Pyrameis atalanta* L.), the Painted Lady (*P. cardui* L.), and the Painted Beauty (*P. virginiensis* Drury), have been found in the Hawaiian Islands during recent years, and in the case of two at least, not until the native food-plants had been introduced. An unusual condition may explain the presence of one insect, but can scarcely be considered as the reason for the establishment of three others many years later, particularly when in all cases the lack of a suitable food-plant appears to have been the determining factor.

The 2000-mile aerial trip of the four butterflies mentioned above still seems rather incredible, and with this in mind we would turn for a moment to the dragon-flies of the Hawaiian Islands. At least two of the larger species are widely distributed in America, and were not found in the Hawaiian Islands until comparatively recent years. Apparently the extensive cultivation of rice and taro has resulted in great expanses of fresh water in which these dragon-flies could breed, and it seems entirely reasonable to think that if the butterflies travelled on the wings of the wind, the same might be true of these dragon-flies, and that the determining factor in each case was the prevalence of conditions favourable to the propagation of the species.

[1] Cf. *Entomologist's Monthly Magazine*, vol. 22, p. 221 (1886) and vol. 50, pp. 230-1 (1914).

Dragon-flies are well known as strong flyers, and there is at least one record of these insects appearing in large numbers in the Indian Ocean about 900 miles west of Australia and nearly 300 miles from the relatively insignificant Cocos-Keeling Islands, tiny land areas where dragon-flies are unable to maintain themselves according to Prof. F. Wood-Jones, and yet frequently visited by considerable flights of these insects, coming with northern winds, presumably from distant Sumatra.

It certainly begins to look as though we must accept the 2000-mile air trip as the most reasonable explanation of the occurrence of these insects in the somewhat isolated Hawaiian Islands, and admit that nearly half that distance is repeatedly travelled by insects journeying over the Indian Ocean. It is perhaps assumed that this is possible only in the case of strong flying insects, such as the larger butterflies and the more powerful dragon-flies. This latter does not necessarily follow. The terrible eruption of Krakatoa in August 1883 devastated that entire group of islands, they being overlaid by hot ashes approximately 90 to 180 feet thick, making it very improbable that anything living could escape, yet twenty years later some 64 species of insects were found upon this seldom visited group, and investigations by Dr. Dammerman, published in 1922, show that certain extremely small flying insects, such as thrips, were represented upon the island by some ten species. He estimates that 80 per cent. of the animals on these islands are winged. Furthermore, the work of naturalists at such outlying points as the Kentish Knock Lighthouse, some twenty-one miles from the nearest points of land, resulted in capturing, among a number of other insects, a delicate plume-moth with somewhat the consistency of a bit of thistledown. Similarly, studies at the Rebecca Shoal Light Station, itself entirely submerged and 12 miles east of the Dry Tortugas, showed the presence of such comparatively inefficient flyers as a lace-winged fly, a damsel-fly or small dragon-fly, and fragile gnats. In other words, insects with supposedly very weak powers of flight undoubtedly drifted considerable distances. Dr. W. L. McAtee records crossing Currituck Sound, N.C., a distance of 6 miles, during which caddis-flies and midges were so numerous over the water that vision was perceptibly restricted and one was constantly annoyed by the impacts of the insects against the face.

These latter records suggest that insects may drift with the wind, and the question may well be raised as to the agencies which make possible the long trips mentioned above. We have become so accustomed to a determinate migration by birds that there is a strong tendency to explain insect movements in the same manner. It is quite possible that some insect movements are direct responses to a migration impulse, but on the other hand there is no proof that such is the case in regard to some of the wanderings discussed above. The physical exertion involved in a 2000-mile trip against the wind is so great that one may reasonably question the ability of even the most powerful flying insects to accomplish this successfully. There is no question but that unusual gales may carry insects enormous distances in the same way that such disturbances force migrating birds far from their normal courses. These occasional and unusual wind currents

do not appear to be the most effective in promoting the spread of insects, though they undoubtedly assist to a material extent. The observations of Prof. F. Wood-Jones as recorded in his "Coral and Atolls" indicate that dragon-flies go to sea of their own accord, and that they are not blown from the shore. He states that in periods of absolute calm of long duration one species of tropical dragon-fly may be seen hawking about over the sea twenty miles and more from the nearest land, and that he has observed numbers of this insect almost daily in a journey through dead calms all the way from Singapore to Thursday Island. He adds that strong-flying butterflies do the same, flying away from the land in a perfectly irresponsible way, and that moths come nightly to a ship's light when she is lying twenty miles from the shore. This condition obtains in other parts of the world, and is evidenced by the insect drift occasionally found along the shores of oceans and lakes in particular. These insects are not necessarily carried out over the water by strong winds. They are simply the normal population of the air which under ordinary conditions, in the case of the smaller lakes at least, would allow themselves to drift across the water, whereas a sudden chilling of the atmosphere, especially if accompanied by rain, results in driving many of them down into the water and their subsequently drifting ashore. According to Mr. C. B. Williams, Acting Chief Entomologist of Egypt, a number of insects drift many miles into the African deserts.

It is our belief that determinate flight is a comparatively small factor in promoting the spread of insects, and that in many cases this is accomplished largely by a drifting with the wind, the stronger flying species probably being able to remain in the air longer than their weaker associates. Much of this long distance spread is very probably made possible through the higher velocities of the upper air strata, the insects gaining these by the aid of convectional currents arising from heated surfaces and now known to extend to a height of at least 1000 feet above the surface. These upper air currents frequently have a velocity of 30, 50, or even 100 miles an hour, consequently a favourable wind for a relatively short time is all that is necessary to carry an insect long distances. This is probably what occurs rather frequently in the early autumn when swarms of "cotton-moths" (*Aletia argillacea* Hubn.), an insect unable to survive north of the cotton-growing area, appear at lights in the northern United States and southern Canada.

Even relatively high wind velocities would mean an insect remaining in the air a day or so, if it were to make the 2000-mile trip from the American continent to the Hawaiian Islands. This is probably within the physical powers of an insect, though it does not necessarily follow that a non-stop journey is made over such an expanse of water. There are several records of the smaller butterflies at least resting upon the surface of the ocean and successfully resuming flight. This has also been recorded of certain grasshoppers, and it appears possible that larger butterflies and even dragon-flies might do the same under extreme conditions.[2]

If the upper air currents are somewhat important carriers of insects, there should be some confirmatory evidence. It is perhaps sufficient to state here that mosquitoes have been met with at an elevation of 3000 feet above the surface, grasshoppers at a height of 2000 feet and honey-bees at approximately the same elevation. Plant spores have been recorded at an elevation of 11 000 feet. These last must have been carried up by convectional currents. Winds tend to drop over the cooler water surfaces and glaciers of the earth, and on these latter exceptionally large numbers of insects have been observed repeatedly, probably forced down by the falling temperatures. Furthermore, collectors on some of the high mountains, such as Mount Washington, have taken insects which are distinctly southern or south-western in habitat, probably carried there by the upper air currents and dropped upon these cooler mountain tops.

It is not suggested for a moment that the appearance of butterflies and dragon-flies in the Hawaiian and other ocean islands is anything more than the outcome of a somewhat irresponsible flight assisted by favourable winds. There is another phase or supposed phase of insect movement deserving notice, that is, the autumn assembling of Monarch butterflies and their apparent southward movement in considerable numbers. There are a number of records of apparently determinate movement by butterflies, mostly in the tropics, and a somewhat similar movement on the part of dragon-flies, in some cases immense numbers of insects coming under observation. These cases may represent a true migration, though this is scarcely established by available data. It is quite within the realm of possibilities that atmospheric or other disturbances may have resulted in an unusual condensation, as it were, of insect life, and that the movements observed followed a change in conditions and were in some instances at least an instinctive effort on the part of the insects to spread out or move away from each other, in order to secure better opportunities for food, either for the insects themselves or their progeny. The account by W. H. Hudson of the dragon-flies appearing in advance of the dry, cold "pampero" in the Argentine, and the record by Gatke of the millions of dragon-flies appearing in Heligoland in advance of a storm and their rapid scattering thereafter, are both very suggestive in this respect.

The fact that various natural causes result in large swarms of insects should not be overlooked in this connexion. The nearly simultaneous development of millions of mosquitoes, midges, caddis-flies, black-flies, and butterflies within a restricted area accounts for many swarms, and these must disperse in some way, if they are to live and provide for their progeny. A movement in any one direction is likely to establish a trend which might easily be mistaken for determinate migration. The observations of Prof. V. L. Kellogg in relation to the winter assembling of the Monarch butterfly in southern California, to revert to this insect once more, suggest that the swarms of this insect may be really the expression of a hibernating instinct rather than a preliminary to migration.

It may appear to some that a rather large part in the distribution of insects has been given to the winds, and comparatively little left to the physical ability and the desire or instinct of the insect. We are considering particularly those individuals which allow themselves to be carried by winds, and in most instances they are

[2] Cf. Seitz, *Macro Lep., Palæarctic Region*, 1, p. 77, *re Danaida plexippus*.

a relatively extremely small proportion. It is very probable that many of these widely ranging forms are somewhat local, if that term is not interpreted too narrowly. On the other hand, we should not expect winds to do less for insects, forms inheriting most admirable organs of flight, than for such wingless creatures as spiders. McCook, a well-known authority, states that ballooning spiders have been found more than 200 miles from land and at elevations of more than 1000 feet. He has concluded from a study of distribution in the tropical regions that these spiders may have actually circumnavigated the globe on the wings of the wind. The known distribution of certain small insects in tropical areas likewise suggests that winds may have played a most important part in carrying these minute, fragile insects. In other words, the ability of the organism to support itself in the air appears to be a most important factor in certain types of distribution.

There is very little question but that representatives of many species of insects are carried far beyond any point where they can possibly maintain themselves. Nature is extremely profuse in her provisions for the continuance of both plant and animal life; the greater the hazard, the more liberal the provision as a rule. It appears reasonable to conclude that winds are carrying millions of insects daily into regions where they cannot possibly survive. A few especially favoured forms may by chance find their way to an area where there are livable conditions. One of the notable instances of this kind was the appearance of a caterpillar on the first crop of tomatoes and peas raised from seed in the out-of-the-way Cocos-Keeling Islands, although it was not a native species, and the parent moth must have travelled hundreds of miles over an inhospitable ocean. A similar case came to the writer's attention recently in connexion with a small patch of corn growing in a Chilean desert. Insects are all about us. Only occasionally do we realise the frequency with which they appear in unexpected places.

Fortunately for man, many of the more destructive species find themselves unable for one reason or another to take advantage of the wings of the wind. An economic application is that insect spread may be somewhat definitely limited by the winds which prevail when other conditions are favourable for dissemination.

Obituary

Dr. John M. Clarke

JOHN MASON CLARKE, who died at Albany, New York, on May 29 last, was one of the foremost palæontologists of America. The son of a schoolmaster at Canandaigua, New York, he was born on April 15, 1857, and received his early education in the school which his father directed. He was inclined in boyhood to the study of geology and natural history, and he proceeded in 1873 to Amherst College, Mass., where he graduated in 1877. At Amherst he came under the influence of the professor of geology, B. K. Emerson, and so entered on his life-work. He began to study in earnest the Upper Devonian rocks and fossils in the neighbourhood of his home, and while holding a succession of small teaching appointments devoted all his leisure to original research.

By the end of 1884 Clarke had made so much progress, that he felt impelled to compare his results with those of European geologists, and he went to spend parts of two years studying under Prof. A. von Koenen in the University of Gottingen. There he graduated with a thesis on Devonian geology in 1885, and after holding another small teaching post, was eventually appointed assistant to Dr. James Hall, the well-known State Palæontologist of New York, in 1886. Thenceforward until his death he was connected with the Geological Survey of New York, becoming State Palæontologist in 1898, and State Geologist as well as Director of the State Museum in 1904.

Clarke's earliest papers on Devonian fossils were published in 1882, and were followed by a long succession which culminated in his two classic volumes, "The Early Devonic History of New York and Eastern North America," published by the Geological Survey of New York in 1908–9. At the same time he studied the Devonian fossils not only of Germany, but also of Brazil, Argentina, and the Falkland Isles. Among his official duties he was also concerned with several other Palæozoic faunas, and he became the recognised authority on Palæozoic invertebrata in America. With Dr. James Hall he published "An Introduction to the Study of the Genera of Palæozoic Brachiopoda" in 1893–94, and with Dr. Ruedemann a monograph of "The Eurypterida of New York" in 1912. Both these are works of reference of permanent value.

In later years Clarke made good use of his ripe scholarship in considering some of the wider problems of the science to which he had devoted his life. As first president of the Palæontological Society of America, in 1911 he delivered an address on "The Philosophy of Geology and the Order of the State," and in 1921 he published a little memoir entitled "Organic Dependence and Disease." He applied his science to questions of state control, and argued that it pointed to individualism, not socialism, as the essence of progress.

Clarke was an attractive personality with very wide interests beyond those of his special work. As head of the State Museum he also controlled the science division of the department of education, and he was associated with many other organisations in the city of Albany. He will be mourned not only as an eminent man of science, but also as a model citizen.

A. S. W.

Mr. D. R. Steuart

DANIEL RANKIN STEUART, late chief chemist to the Broxburn Oil Co., Ltd., died at his residence, Blackhall, Edinburgh, on August 1. He was a well-known figure in scientific circles in the east of Scotland, and was a recognised authority on the chemistry and technology of shale oil and petroleum. Born at Bogside, Lanarkshire, in 1848, he studied botany and geology in his early youth, and, for reasons of health, spent some ten years in the open-air pursuits of gardening and farming; he received his chemical training at

the University of Edinburgh under Crum Brown, at Glasgow under Dittmar, and finally at Munich His connexion with the shale oil industry, destined to be a lifelong one, began about 1875, when he became a laboratory assistant to the late Sir George Beilby at the Oakbank Oil Works In 1877 he was appointed chief chemist to the Broxburn Company, and retired from that post five years ago

Mr Steuart was a strenuous worker, endowed with a mind of exceptional intellectual insight and power His writings are well known, and include a number of articles, contributed to the Transactions of the Society of Chemical Industry, on the shale oil industry, petroleum, and brown coal, some of these are of practical interest, others in speculative vein To the same Society he read a paper entitled "The Oxidation of Mineral Oils," and edited and read one by his nephew, Mr B Steuart, on "The Composition of Shale Naphtha" It was one of his regrets that his routine duties did not permit him to devote more time to organised research, he, however, strongly advocated the desirability of industrial research being taken up by qualified university workers That his eminence as an authority on shale was widely recognised is attested by articles written by request to "Economic Geology" (U S), Ure's "Dictionary," Muspratt's "Chemistry," Thorpe's "Dictionary of Applied Chemistry," and an important contribution to the memoirs of the Scottish Geological Survey entitled "The Chemistry of the Oil Shales" In the last mentioned he propounded a theory referring to the origin of oil shales

Mr Steuart's humane instincts led him, in 1890–95, to direct public attention to the number of deaths caused by the use of low flashing burning oils in lamps He wished the standard of flash point to be raised from 73° F to 100° F, and gave evidence on the subject before a Select Committee of the House of Commons during the reading of the Petroleum Bill The measure was unsuccessful, but as the light constituents of petroleum (the cause of low flash point) afterwards became valuable as motor fuel, Mr Steuart had the satisfaction of seeing burning oils made safer by the elimination of much of the danger in the refinery

R H Findlater

Prof O Brefeld

The death was recently announced of Prof Oscar Brefeld, the founder, and for fifty years a leader, of modern mycology Born at Telgte in Westphalia, on August 19, 1839, the son of a wealthy pharmacist, whose business he was intended to inherit, he early took an interest in the lower plants, but it was not until 1868 that he began his mycological studies in earnest At the outset he realised the necessity of sterilising the culture media and the apparatus, and of studying microbes and spores as individuals For this purpose he introduced gelatine—which he replaced later by agar-agar—and devised the method of pure culture by thinning the medium so as to grow a colony from a single cell under continuous microscopic observation Thus he laid the foundation of all subsequent microbiological study ten years before R Koch took up the inquiry

In 1870 the contemporary work of Pasteur led a Munich brewery to seek the assistance of Brefeld Here he gained experience and a crop of fruitful ideas, but his work there was cut short by the Franco-Prussian war From the siege of Paris he was invalided home after an attack of typhus and prosecuted his studies in Berlin Here he took his doctor's degree, and in 1872 published the first volume of his great life work "Botanische Untersuchungen aus dem Gesammtgebiete der Mykologie" (18 vols) known as the mycologists' Bible The following year saw the publication of his epoch-making researches on the Ascomycetes, especially on the cultivation of the blue mould *Penicillium glaucum* from a single spore to a mycelium with complete fructification One cannot here go through the contents of successive volumes, but his important work on *Bacillus subtilis*, undertaken for the Prussian Government in 1878, demands mention Brefeld did not, however, pursue bacteriology, feeling that his medical knowledge was too slender Robert Koch was therefore substituted to become the "German Pasteur"

Brefeld, after habilitating as privat-docent in Berlin, became, in 1876, professor at the Forestry Academy in Eberswalde Here he lost the sight of one eye As a consequence of the "Kulturkampf" he was urged by the Government to become professor of botany at Munster in Westphalia Here he continued to publish the most valuable work, until his removal to Breslau in 1898 In the year before the War, Brefeld resided in Berlin, where he lectured, but he became completely blind and had to resign his professorship

Brefeld was a hard worker, entirely bound up in his life-work He did not care to have pupils, but he trained a succession of assistants, among whom may be mentioned the Germans, Zopff, Alfred Moller, and R Falck, the Norwegians, Holtermann and Sopp, the Swiss, Von Tavel, and the Hungarian, Gyula de Istvanffi We are indebted to an article by Dr Sopp in a recent issue of *Naturen* for the details of Brefeld's life

We learn from the *Chemiker-Zeitung* with much regret that on August 4, shortly before his fifty-fifth birthday, Dr Friedrich Auerbach, younger brother of the physicist Dr Felix Auerbach of Jena, and well known as the collaborator with Abegg in the "Handbuch der anorganischen Chemie," died suddenly of heart failure Auerbach studied at his native town, Breslau, under Ladenburg, to whom for a while he acted as assistant, after which he was engaged for several years in industrial work But his real interest lay in scientific investigation, and in 1903 he returned to Breslau, where Abegg had recently begun to build up a flourishing school of chemistry Shortly afterwards he was transferred to the Imperial Health Department At Breslau, Auerbach devoted his attention chiefly to physical chemistry, and he published many papers dealing with the theory of electrolytic dissociation and the theory and practice of the electrometric titration of acids After the death of Abegg in 1910, Auerbach undertook the onerous task of editing the "Handbuch der anorganischen Chemie" Before the War he was a member of the International Association of Chemical Societies

Current Topics and Events

A LARGE party from Section D (Zoology) of the British Association visited Hayling Island on Monday for the formal opening of the British Mosquito Control Institute which has been built there by Mr J F Marshall Anti-mosquito work was commenced at Hayling in 1920, and we have on several occasions referred to the very valuable results achieved By draining and other operations, the mosquito nuisance in the district has been almost entirely removed and the measures adopted have been followed with success at other places around the coast Mr Marshall's work in connexion with both salt-water and fresh-water mosquitoes has become so widely known that inquiries from medical officers and others continually reach him from many parts of the country, and numerous people interested in the subject have visited Hayling to see his laboratory and his control work in inter-tidal and other areas This led to the erection of a building containing a demonstration museum, laboratory, drawing office, photographic room, and other facilities for study and research in various branches of mosquito control work The building, the design and equipment of which are based upon five years experience in the laboratory and the field, is the first example of an institution devoted exclusively to what may be termed the non-medical side of mosquito investigation Sir Ronald Ross, in an address at the opening ceremony, described the growth of the organisation at Hayling and expressed high appreciation of Mr Marshall's work, both as to its scientific value and practical service We hope to give some further particulars of the Institute and the opening ceremony in our next issue

THE recommendations of the Committee on the use of preservatives and colouring matters in food have already been noticed in these columns (February 14, p 217) It will be remembered that the Committee considered that the use of boric and salicylic acids and their salts should be prohibited completely, that sulphurous and benzoic acids and their compounds should be permitted in certain articles of diet in quantities not exceeding a definite limit which varied according to the food, and that a list of permissible colouring matters should be drawn up The Minister of Health has now issued regulations under the Public Health Acts dealing with this subject (The Public Health (Preservatives, etc , in food) Regulations 1925 Statutory Rules and Orders 1925 No 775, and Circular 606 London H M Stationery Office 3*d* and 1*d*) Certain previous regulations as to the use of preservatives in butter and cream are revoked and the use of any thickening substance in the latter is forbidden The foods in which preservatives are allowed, whether sulphur dioxide or benzoic acid, and the maximum amount permissible are given in a schedule it will be remembered that the articles of diet concerned are sausages fruit preparations, wines, non-alcoholic beverages, syrups, gelatin, coffee extract pickles and sauces As regards colouring matters, a short list of those forbidden has been drawn up and includes certain metallic salts, a few coal-tar dyes and gamboge The regulations include a section prohibiting the sale as a preservative of any article the use of which as a preservative is forbidden, and also details as to the labelling of certain of the food products in which a preservative is permissible and of articles sold specifically for use as preservatives The regulations come into force on January 1, 1927, except in the case of butter and cream, where their operation is postponed for a further year

THE issue of the Journal of the British Science Guild for August contains a valuable report prepared by a committee of the Guild on the supply of trained research workers in Great Britain and their utilisation in industry According to it, in the year 1923–24, the number of full-time students of science at British universities was 60 per cent greater than in 1913–14 , the number of students who obtained science degrees was three times and the number engaged in full-time scientific research four times, the corresponding numbers in the former year While the universities are in this way doing what they can to supply the industries with the research workers they require if they are to hold their positions against their competitors, the industries themselves are doing little to absorb the trained men available This is particularly the case in the chemical industry and the Department of Scientific and Industrial Research has taken steps to reduce the number trained in this subject The committee recommends that a staff of research workers should be maintained in a national institution, and that any firm should be able to secure the services of one or more of them for work at its own private problems

IN a recent address to the American Institute of Electrical Engineers, published in the June issue of the Journal of the Institute, Mr E M Herr discussed the future of railway electrification Up to June 1924, the electric locomotives built and under construction in the world numbered 2351, of which the aggregate horse power was more than four million Of these locomotives 905 were operated by direct current In Italy there were 504 locomotives and in the United States 465 Then came France, Germany, and Switzerland with 366, 304, and 214 locomotives respectively No other country had so many as 150 electric locomotives in service Great Britain, however, has constructed and is constructing a large number of electric locomotives for use overseas One curious development in the Italian railways is the use of portable substations These are of use in the event of a breakdown of an ordinary substation or when part of the line gets overloaded All the devices, including 100,000 volt transformers are carried on a railway bogie waggon frame which can be coupled to an ordinary train and travel at a speed of 50 km (31 miles) per hour At present they are in regular use in places where the substations have not yet been constructed One of these substations is being exhibited at the Grenoble Exhibition

IN an address to the Water Power Congress held at Grenoble in July, a translation of which appears in *Engineering* for August 14, Mr Bouchayer discusses the regulation of the import and export of electrical energy between neighbouring countries In France the demand for electric energy greatly exceeds the supply, and so the main problem is concerned with the import of electrical energy from abroad Switzerland supplies most of the imported energy Belgium supplies energy to both works and distributing stations A small amount of energy also is transmitted across from Italy and Spain The amount sold to French consumers in 1923 by the Swiss hydro-electric industry amounted to 521 million kilowatt hours and is constantly increasing This export is watched with some misgivings by the Swiss Federal Council They are afraid that the use of cheap hydraulic power may enable a foreign industry to compete successfully with one of their own Should there be a drought, the export "permits limit seriously the amount of energy that can be transported, and this may be very awkward for the foreign consumer The suggestion is made that the Swiss law should provide for an indemnity when an authorisation is withdrawn From the point of view of the French authorities, the import of cheap energy may prevent the development of French hydro-electric power, which, as it has in general to be transmitted over long distances, cannot be sold so cheaply Mr Bouchayer suggests that an inquiry should be held and also that a tax should be put on energy imported over a distance of 100 km (62 miles) into France The tax suggested is 0 005 franc per kilowatt hour Electrical energy should only be imported within the limits required by the national interest

THE Rowett Research Institute has recently issued Volume I of Collected Papers consisting of 62 communications to a score of different journals All but two of these have been published within the last five years The wide distribution of these publications, serving as they do the sciences of agriculture, bacteriology, chemistry, and medicine, make it most convenient to have all the publications in one volume The name of the editor of the volume, Dr J B Orr Director of the Institute, is associated with half the papers The field of research covered by a number of investigators in four different departments is naturally extensive but the activities of the Institute as a whole have been focussed on problems of nutrition Although much work has been published on the subject of calorimetry, the staff, while recognising the importance of this aspect of nutrition, realised that other essential factors had in the past been neglected Several papers are devoted to work on vitamins, but this work seems to have stimulated a reluctance to accept the explanation of deficiency of these accessory factors as the chief cause of lack of growth and of such diseases as rickets attributed to vitamin deficiency by the majority of modern investigators Other possible explanations have therefore been sought, the neglected field of mineral metabolism offering the most scope for work The possibility of a lack in the food supply of any of the normal mineral constituents of the animal body *e g* calcium phosphorus, iron, etc and the effects produced by deficiencies of these substances, are complicated by hypotheses of the necessity of rigid mineral balances in the food, thus presenting a very wide field for investigation The Rowett Research Institute is to be congratulated on the whole-hearted way in which the staff has attacked these problems for much more work on animal nutrition is urgently required by our oldest industry to make good the deficiencies arising from new animal environments It is well to remember, however that this is the output of only five years work, and the too speedy application of scientific results to agricultural practice has its dangers

THE British Research Association for the Woollen and Worsted Industries Torridon, Headingley, Leeds is awarding next session a number of research fellowships and advanced scholarships The fellowships will be of the annual value of not more than 200*l* each and are tenable at an educational institution or at a works The scholarship grants are such as to cover expenses and maintenance and are intended to enable students to specialise after completing their secondary or university education, they are also open to factory workers A wide choice of studies is available to textile students who enter for these scholarships

APPLICATIONS are invited for the following appointments, on or before the dates mentioned An assistant lecturer in agricultural zoology in the department of agriculture of the University of Leeds—The Registrar, The University, Leeds (September 14) A lecturer in metallurgy in the University of Liverpool—The Registrar, The University, Liverpool (September 15) A secretary to the Public Instruction Committee, Jersey—The President, Public Instruction Committee, Greffe Office, Jersey (October 1) The Jenner Memorial Research Studentship at the Lister Institute of Preventive Medicine—The Secretary, Lister Institute, Chelsea Bridge Road, S W 1 (October 3) A director of the new pharmacological laboratories of the Pharmaceutical Society of Great Britain—The Secretary, Pharmaceutical Society of Great Britain, 17 Bloomsbury Square, W C 1 (October 5) A senior lecturer in philosophy in the University of Melbourne—The Agent-General for Victoria, Melbourne Place, Strand, W C 2 (October 15) A director of the department of medical entomology and lecturer on noxious and venomous animals at the London School of Hygiene and Tropical Medicine (Division of Tropical Medicine and Hygiene)—The Secretary of the School, 23 Endsleigh Gardens, N W 1 (October 31) An assistantship in the Department of Logic of the University of Glasgow—The Secretary, The University, Glasgow A junior scientific assistant in the ignition and electrical department of the Royal Aircraft Establishment—The Superintendent, Royal Aircraft Establishment South Farnborough, Hants (quoting A 78) A chemist in the establishment of a large textile firm—The British Woollen Research Association, Torridon, Headingley, Leeds

Our Astronomical Column

PLANETARY TEMPERATURES.—Dr. W. W. Coblentz's pioneer work on the measurement of the heat of the stars by means of the vacuum thermocouple is well known. In conjunction with Dr. Lampland of the Lowell Observatory, he has recently made similar observations of the heat radiation of the planets and the moon, and the results are published in the June and July issues of the Journal of the Franklin Institute. The substances water, quartz, glass, fluorite, and rock salt are found to be practically opaque beyond the wave-lengths 1.4μ, 4.1μ, 8μ, 12.5μ, and 23μ respectively, whilst the atmosphere itself is opaque beyond 15μ. By the use of screens made of the materials mentioned, it was therefore possible to obtain thermocouple measurements of the radiation incident in the regions 0.3μ to 1.4μ, 1.4μ to 4.1μ, 4.1μ to 8μ, 8μ to 12.5μ, and 12.5μ to 15μ. From these measures the true planetary radiation could be found by subtracting the reflected solar light (0.3μ to 1.4μ) from the total radiation, and the spectral composition of the remainder enabled the planetary temperature to be estimated.

The most interesting of the results are those referring to Venus and Mars. Observations on Venus showed that when the bright phase was a narrow crescent the dark part emitted an intense planetary radiation (in the region 8μ to 12μ) amounting per unit area to one-tenth of the total radiation from the bright crescent. It is pointed out that this suggests either a short rotation period for the planet or a hot interior. The region near the south cusp was hotter than that near the north, but long-continued observations will be necessary to settle whether this is a seasonal effect. If it is seasonal, the possibility of determining the position of the axis of rotation is foreshadowed.

Extensive observations of Mars were made during the opposition of 1924. The dark regions were found to give an appreciably higher temperature than the bright regions. The noon-day temperature of the bright regions on the equator came out as 5° C., that of the adjacent dark regions as 20° C. At the same time the east (sunrise) limb gave −45°, the west (sunset) limb 0°. These results show a huge diurnal range of temperature for points on the equator, indicating a rare atmosphere. The temperature of the north polar region was found to be steady at about −70°, but that of the south polar region rose gradually from −68° to +10° as the summer season in the southern hemisphere advanced. The temperature of the night-side is thought to be probably below −70° C. The integrated temperature of the whole disc was −30° C. for the month of July 1924.

THE GRONINGEN ASTRONOMICAL LABORATORY.—This institution, founded by Prof. Kapteyn, is continuing its labours under the direction of Prof. P. J. Van Rhijn. Publications 36, 37, 39 have recently come to hand. No. 37 is a discussion of the systematic errors of the trigonometrical and spectroscopic parallaxes published by several observatories. It is well known that systematic differences exist in the parallaxes found at different observatories. Prof. Van Rhijn seeks to determine the true values by correlating angular proper motions with linear velocities for different groups of stars. Systematic errors in the assumed trigonometrical parallaxes necessarily enter also into the spectroscopic ones, since the curves of line-intensity are based on trigonometrical results.

Prof. Van Rhijn revises the Groningen statistical parallaxes given in publication 34, reducing them on the average by 10 per cent. Comparing them with the Victoria spectroscopic parallaxes, he finds the following corrections to the latter: Spectral types F, G, K, correction −0.005″; type M +0.004″.

Publication 36 is a study of the number of stars of each spectral class between definite limits of proper motion, visual magnitude and galactic latitude.

No. 39 is a list of 656 proper motions of faint stars deduced from Helsingfors plates. The largest two centennial motions are 129″ (mag. 10.2) and 38″ (mag. 13.1).

MULTIPLE STARS.—F. Henroteau of the Ottawa Observatory contributes an interesting paper to the July issue of *La Science moderne* describing some multiple stellar systems. Many of these are studied spectroscopically, and also photometrically with the photo-electric cell.

σ Scorpii consists of a Cepheid, the pulsation period of which is about 6 hours, having a companion with orbital velocity of some 35 km./sec. and period 33 days. There is a more distant companion the period of which is 12 years. The motion of the Cepheid in this large orbit causes its light variations to be alternately accelerated and delayed, owing to the change in its distance.

σ Cygni is stated to have a density $\frac{1}{1000}$ of the sun's, and a mass 10 times the sun's, while its companion has a diameter $\frac{1}{5}$ of that of the primary, and a mass 7/100 of the sun's, which if confirmed would make it the least massive body yet recognised outside the solar system. Rigel and α Cygni are suspected to have similar small companions, but the detection of such small masses by changes in the line-of-sight velocity is necessarily a very delicate matter.

Prof. Guthnick has studied the eclipses of σ Cygni photometrically, and states that they last about 3 days, their period of recurrence being 11 days.

OBSERVATIONS OF STARS OF SPECTRUM TYPE Be.—Stars of spectrum type B are hot stars and those which show bright lines in their spectrum are of particular interest because their study will no doubt throw light not only on the conditions of their atmospheres, but may also help to interpret the spectra of new stars and unusual properties of the hydrogen atoms. In the spectra of these stars the hydrogen lines are sometimes very complex, such as was recently described in this column in the case of ϕ Persei as studied at the Norman Lockyer Observatory by Dr. W. J. S. Lockyer. The intensity of the bright hydrogen lines usually decreases from the red to the violet, and as the ordinary photographic spectrum only extends from $H\beta$ to the ultra-violet, it might occur that while $H\beta$ and the other lines towards the violet were not bright, the line at $H\alpha$ might appear as a bright line. In fact, most of the so-called bright-line B stars have been discovered because $H\beta$ or the other hydrogen lines towards the violet were bright.

A recent investigation by Paul W. Merrill, Milton L. Humason and Cora G. Burwell (*Astrophysical Journal*, vol. 61, p. 389, June), has been devoted to the study of the $H\alpha$ line of B stars, with the result that 90 more bright-line B stars have been discovered. Indeed the discussion brings out the fact that the objective-prism spectrograms have yielded more new bright-line stars than the number previously known within the areas observed. This great increase in the number of these stars has led the authors to inquire into their distribution in the heavens. The result of this study is to show that there is a tendency for them to fall into groups near the centre line of the Milky Way. Four of these groups occupy areas which are also rich in Wolf-Rayet stars. Further, the frequency of bright-line stars in the various spectral divisions has also been examined, and it is found that the spectrum classes B0 to B5 are strongly favoured. The communication includes numerous tables and illustrations, and is a valuable contribution to the study of bright-line stars.

Research Items

QUATERNARY MAN IN CHINA.—An important addition to our knowledge of the distribution of man in the Pleistocene age is made by the researches of MM. Licent and Teilhard de Chardin, of which a preliminary account is given in Vol. 35, Pts. 3-4 of *L'Anthropologie*. While engaged in examining the quaternary deposits of southern China, they discovered three sites affording evidence of occupation by palæolithic man. The first is situated in the basin of the Choei-tong-k'eou immediately to the south of the Ordos plateau and to the east of the Yellow River, where was found a sharply defined zone of occupation of about 20 m. in length with a deposit of 50 cm. thickness. Upon it was superimposed a bed of loess about 15 m. deep and above this the gravels of a pre-neolithic river. No human remains were found, but a quantity of fossil bones of *Bos primigenius*, *Rhinoceros tichorhinus*, hyæna, and the tooth of, probably *Ovis Ammon*. Stone implements were very numerous and of various forms, all being worked on one side only. They were rude in form and rough in workmanship, this being due to the coarse grain of the material employed. At the same time a few scrapers and points showed that, given suitable material such as flint, man here was capable of fine work. Five hearths were discovered in the neighbourhood within an area of about a square kilometre. The third site was found on the Sjara-osso-gol a tributary of the Hoang-ho, and has yielded the complete skull of a rhinoceros and bones of a species of elephant, *Rhinoceros tichorhinus*, Equus, Cervus *Bos primigenius*, *Hyæna spelæa*, etc. The lack of suitable material in this area has affected the character of the stone implements, which, with a few exceptions are extraordinarily small. Notwithstanding this difference, this site and that at Choei-tong-k'eou may be regarded as contemporary. No traces of industry intermediate in date between this palæolithic culture and the neolithic have been discovered. Although comparison with European cultures is difficult, these sites may be classed as Mousterian or early Aurignacian.

OBSERVATIONS ON A COLLARED FLAGELLATE.—Dr. G. Lapage (*Quart. Journ. Micr. Sci.*, June 1925), records observations upon living specimens of the choanoflagellate *Codosiga botrytis* made with the view of ascertaining the nature of the collar and its function as a food-catching apparatus. Study of the organism does not support the view put forward by some previous observers that the collar is a spiral; Dr. Lapage holds that it is, as earlier workers stated, a protoplasmic, flexible, retractile, conical membrane, closed on all sides except on its upper free surface. The flagellum which arises in the base of the cup and the currents it produces are carefully described. They cause food to be brought to the collar, by which it is caught and passed down the outside of that structure to be ingested at or below the middle of the body, and not at its upper end and never by the area enclosed by the collar. The method of ingesting the food is fully described. Defæcation invariably occurs from the area enclosed by the collar. There are normally two contractile vacuoles; one of these has been misinterpreted as a "gullet-vacuole" at which food was said to be ingested. Dr. Lapage has not met with any examples which exhibited division, encystment or conjugation.

RECOVERY FROM PLASMOLYSIS.—It has been almost axiomatic amongst botanists to interpret recovery from plasmolysis, when a living cell is immersed in a hypertonic salt solution, as due to the gradual entry of the salt. When the plant cell is immersed in sugar solution or in solutions of certain salts no recovery takes place and the sugar or the salt in question is assumed not to penetrate the cell. This interpretation of recovery from plasmolysis will need reconsideration in the light of a recent paper by W. S. Iljin (Studies from the Plant Physiological Laboratory of Charles University, Prague, vol. 2, 1924). Iljin points out that the salts which have thus been assumed to penetrate the cell all appear to possess the property of facilitating the hydrolysis of polysaccharides such as starch. The result is the formation of soluble organic compounds within the cell, which raise its osmotic pressure in many cases to a value far higher than would be attained simply as a result of the entry of the salt itself. Salt solutions in which recovery from plasmolysis does not take place also fail to promote hydrolysis of starch. How the monovalent cations and organic anions thus found to be active in hydrolysis produce their effect is not apparent, but Iljin is emphatic that he sees no evidence of any considerable penetration of the cell by these ions.

NORTH-EAST LAND, SPITSBERGEN.—Mr. F. G. Binney gives an account of the Oxford expedition to North-East Land in the *Geographical Journal* for July. This is followed in the August issue by summaries of the scientific results by various members of the expedition. Some additions to the topography and geology have been made. On the east coast a low-lying spit of granitic and metamorphic rock was discovered and named Isis Point. Its position was found to be lat. 79° 42′ N., long. 26° 40′ E. No islands such as had previously been reported, were found off the east coast. Soundings showed that the ice cap along this coast is aground and not floating and there is evidence that it is receding at no mean rate. In the interior of North-East Land no features exactly tallying with A. E. Nordenskjold's "ice-canals" were found but wide crevasses with parallel vertical sides were numerous. They were of great depths and often partly choked with snow but a definite floor such as Nordenskjold described was never seen. It is probable, however, that these crevasses were of the same nature as the features discovered by Nordenskjold.

RAINFALL VARIATIONS OF GREAT BRITAIN.—The *Meteorological Magazine* for June contains an article by Mr. C. E. P. Brooks, of the Meteorological Office, on "Long Period Variations in the Rainfall of Great Britain." The author makes a praiseworthy attempt at grouping past records of rainfall and associating with them the earlier historical records of weather such as storms, floods, and droughts. With the aid of previous work done by G. J. Symons, E. J. Lowe, and Sir Richard Gregory, an approximation is made of the variations of rainfall in Britain since A.D. 1000. Approval is expressed of conclusions obtained by Symons, which is a satisfaction to those who knew Symons' work, and the scrupulous care with which he originated and handled rainfall results. A diagram is given to show the fluctuations of rainfall since A.D. 1000. Prior to 1700 the results are based on generalisations by old chroniclers, and it is only claimed that a rough approximation is obtained; but from 1700 onwards the results are based on actual measurements. There is probably no one who can better claim respect in this research than Mr. Brooks, and the article is of especial interest.

INSTANTANEOUS COLOURED PHOTOGRAPHY.—A method of obtaining coloured photographs by means

of a single very short exposure is described by M G A Rousseau in the *Comptes rendus Acad Sci* Paris, July 20 Three films are employed, the first of which has an ordinary slow emulsion, the second is coloured yellow with auramine on the side towards the lens, and pale rose with fuchsine on the other side and has an emulsion which is sensitive to yellow and green, while the third film is coated with an emulsion which is sensitive to yellow and red The three films are cemented together along one edge, and pressed together in the camera by means of springs between a thin metal plate and a glass plate The photograph is taken in the same way as an ordinary one, no screen being required The blue-violet radiations act on the first film, and are largely absorbed by it When this is developed it serves as a yellow positive The radiations which pass through the first film are further filtered by the yellow dye on the outside of the second film, so that no blue-violet radiations pass to the sensitive layer, which is acted on by the yellow and green radiations giving a red positive Finally, the remaining yellow and green is filtered out by the fuchsine on the back of the second film, so that only the orange group passes to the third film, which gives a positive in which the bright parts correspond to the blue in the object photographed Monochromes can then be printed in the proper colours from the three films, and when these are superposed, the object photographed is seen with its natural colours

Polarisation of the Atom Trunk —The observed differences between the spectra due to a photo-electron, which circulates in orbits at a distance from the nucleus considerably greater than those of the remaining $n-1$ electrons, and the spectrum calculated from the Balmer formula of hydrogen, have been ascribed to the fact that the photo-electron polarises the atom trunk, so that the configuration of the trunk, to a certain extent follows the radius vector of the electron in synchronism The result may be to introduce a term into the law of the force field in which the electron moves, depending on $1/r^3$ or some higher inverse power of r, the distance from the centre of the nucleus In the *Annalen der Physik* for June, Dr E Schrodinger calculates the capacity for polarisation, P, of the "neon" trunk for the d terms ($k=3$), and the f terms ($k=4$) of Na I, Mg II Al III and Si IV, and finds that P is nearly constant in each series when n varies from 3 to 7 A table based on the arc spectra of the alkali metals (inert gas trunks) shows some regularities and some irregularities in the values of P A remarkable irregularity discovered by Paschen in the Bergmann series of Al II is explained by assuming that, for frequencies a little smaller than the resonance frequency of the trunk, P is large, and for higher frequencies is negative, this depends on the loosening of the structure of the trunk at the resonance frequency The relations for the arc spectra of the alkaline earths are not very clear, and the explanation given in the case of Al II is to be taken with a certain amount of reserve in consequence

Sulphur Sesquioxide —The Journal of the Chemical Society for July 1925 contains an interesting paper by J R Partington and I Vogel on sulphur sesquioxide There has always been some doubt as to whether the blue substance formed by the interaction of sulphur and sulphur trioxide was a definite compound or a colloidal solution The present authors have proved that it is a compound, S_2O_3, analogous to the well-known $SSeO_3$ and $STeO_3$, which are formed in a similar way The properties of the oxide are described as well as futile attempts to isolate sulphur monoxide

Nickel —Dr M Cook contributes an interesting article on nickel to the *Chemical Age* for August 1 Copper-nickel alloy was in use so early as 235 B C, but nickel itself was not isolated until 1751, by Cronstedt The chief sources are the ores of Sudbury (Canada) and New Caledonia Pure nickel cannot, in general, be worked, it is made malleable by the addition of about 0 1 per cent of magnesium, a discovery due to Fleitmann The function of the magnesium is to break down the nickel sulphide which occurs as films around the nickel crystals and so renders the metal brittle Magnesium sulphide insoluble in molten nickel, is produced and occurs disseminated throughout the solid metal The influence of various impurities on the properties of the metal is discussed The mechanical properties of the metal are listed and the numerous methods of working are briefly described Some of the toughest non-ferrous alloys known contain nickel The metal is finding numerous uses, and more than seventy countries utilise it or its alloys for coinage purposes

Diagnosing Potential Optical Activity —An important article on the detection of potential optical activity, by Prof John Read and Miss A M M'Math appears in the July number of the Journal of the Chemical Society Until 1914 no one-carbon molecule had been obtained in optically active modifications In that year, however, Sir William Pope and Prof Read succeeded in resolving chloro-iodomethanesulphonic acid, and found that the active forms showed pronounced optical activity This rendered the lack of success which was experienced in attempting to resolve chloro-bromomethanesulphonic acid all the more remarkable Prof Read and Miss M Math have now found that by salt-formation between this acid and *l*-hydroxyhydrindamine in organic solvents, and subsequent recrystallisation from acetone containing a little methyl alcohol, two salts are produced which differ widely in crystalline form and solubility Their specific rotatory powers are different in organic solvents, but identical in water and both salts show a remarkable mutarotation in certain organic solvents The authors adduce evidence to show that these salts are to be represented as *lBlA* and *lBdlA* respectively, and that in pure dry acetone either of them rapidly attains an equilibrium of the following kind

$$\underset{81\text{ per cent}}{lBlA} \rightleftarrows \underset{19\text{ per cent}}{lBdA}$$

The diastereoisomeric salts thus exist in dynamic equilibrium, and the whole of the original acid may be removed in the form of the less soluble salt, *lBlA* This salt changes instantaneously into the partial racemate, *lBdlA*, in contact with water, which apparently exerts a potent catalytic racemising effect even when added in small amounts to solutions of *lBlA* in organic solvents The authors advance the view that asymmetric carbon compounds of simple molecular constitution are as a rule exceedingly susceptible to racemisation, owing to the mobility of the groups attached to the asymmetric atom Easy racemisation involves the complementary possibility of easy optical stabilisation under an appropriate asymmetric influence, and the new method of diagnosing potential optical activity is based upon this principle The authors "anticipate that asymmetric compounds containing two carbon atoms in the molecule will also display phenomena of the kind now described, and thus lend themselves to preparation for the first time in optically pure combinations by treatment with optically active bases in organic solvents Through a systematic application of the method to asymmetric compounds of simple molecular constitution, it is hoped to gather much new information respecting the comparative mobility of groups in systems of the kind"

Developments in Gas Calorimetry

By Dr J S G Thomas

Section 5 of the Gas Regulation Act, 1920 requires that, in certain cases apparatus for testing towns gas "shall include a calorimeter for the production of a continuous record of the calorific value of the gas which is being supplied" During the interim period of development of a suitable and satisfactory recorder, the statutory testing of the calorific power of gas has in accordance with the specification of the Gas Referees been done in practically all cases by determinations of calorific power made at specified periods with a Boys calorimeter The cost and elaborate procedure at present necessitated by this method of testing have become a serious burden,

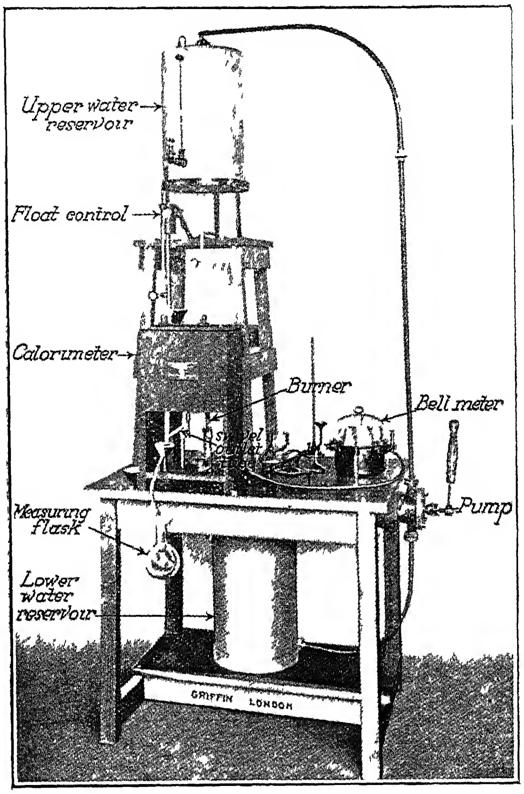

Fig 1

particularly in small country places, and with the view of reducing these difficulties Prof C V Boys has designed a simple equipment which he described at the meeting of the Institution of Gas Engineers on June 10 last The apparatus is illustrated in Fig 1

Water required for the test is contained in an upper reservoir, and after passing through the calorimeter is received in the tank or lower reservoir below the table, whence it may be restored to the upper reservoir by operation of the handle of the pump, the water entering at the bottom of the upper reservoir, so that by continuing the pumping operation air is forced into the water, the consequent stirring ensuring uniformity of temperature The customary overflow funnel system for determining the water rate through the calorimeter has been replaced by a float control, resembling a carburettor in design Water passes from the calorimeter by a swivel outlet tube moving between stops, so that the water may either flow to the lower reservoir or be collected in a measuring flask during the actual test Prof Boys has, very reluctantly, been obliged to abandon the use of "onazote" which he employed in the construction of his "Block" calorimeter as a water-containing and insulating material and has reverted to a construction very similar to that employed in his recording calorimeter (Nature, August 19, 1922, p 251) for the water circulation within the present "Box" calorimeter

Gas to be tested is efficiently governed and passes through a micrometer tap to a Boys "Bell Meter" and thence to a burner consisting of a narrow inner tube terminating within a plain silica tube open above and below There are no moving gas connexions and as the gas is somewhat aerated before combustion it is possible to burn as much as one cubic foot per hour without risk of imperfect combustion Readings of inlet and outlet temperatures of the water passing through the calorimeter may be taken after the burner has been alight about 15 minutes

The Boys "Bell Meter," shown also in Fig 2, incorporates some of the essential features of the meter employed in Prof Boys's recording calorimeter

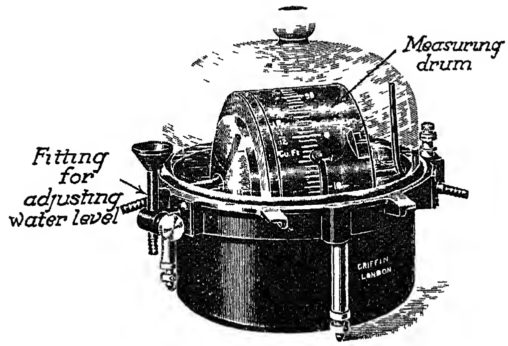

Fig 2 —Boys ' Bell Meter

(Nature, *loc cit*) A celluloid or nickel drum is graduated along its circumference and is supported on an axle moving in bearings in water, no stuffing box being employed A buoyancy chamber supports most of the weight of the drum and forms a solid floor to the major part of each compartment of the drum when gas is trapped within it The water level is determined by a submerged needle Water may be added to or run off from the meter by means of the fitting seen on the left of Fig 2 By these means the tiresome operation of meter-proving becomes unnecessary

In the case more especially of small gas undertakings, where financial considerations unduly limit the number of tests of calorific power of the gas supplied, it is difficult to ascertain the mean value of the gas supplied over the statutory period The consequence of the present procedure is that small gasworks, in order to prevent an adverse report have to provide gas which on the whole is of higher calorific value than that declared Prof Boys suggests tentatively that in the case of such undertakings the gas supply over any period should be sampled by being slowly and continuously drawn into a small holder in the testing place, maintained if necessary at a uniform temperature, and that the sample so collected should be tested by the Gas Examiner Owing to the small rate of gas flow and the short time taken, less than half a cubic foot of gas is sufficient for a test In an apparatus designed by Prof Boys for such sampling

the gas lifts a balanced bell at a rate controlled by a clock A chain from the bell to a balance weight made as a sprocket chain passes over a sprocket wheel connected by a clutch to a clock-turned axle, the clutch acting in such a direction that the bell cannot rise faster than the clock permits, whilst it is always free to descend when weighted This system of clock control of sampling lends itself readily to any agreed scheme of variation of the rate of sampling which may be considered equitable and in accordance with the variation of the rate of gas supply to the district during the hours of day and night Should experience show that there is no loss of quality due to sampling and storage, the method would ensure one of the most important objects of the Gas Regulation Act being attained

The Transmission of Excitation in Plants

THE question of the mechanism of transmission of excitation in plants has been for some time under discussion in the columns of NATURE The most recent contribution to the discussion is a paper by Sir J C Bose, entitled "Physiological and Anatomical Investigations on *Mimosa pudica*," published on August 1 in the Proceedings of the Royal Society (No B 690, vol 98)

The first section of the paper is devoted to the vexed question of the nature of the process of transmission It has been suggested by Prof Ricca that it is purely physical, a stimulating substance (hormone), produced at the seat of stimulation is conveyed to the motile leaves by means of the transpiration-current in the vessels of the wood Another suggestion, that of Mr R Snow, is to the effect that whilst Prof Ricca's explanation may apply to transmission through relatively long distances in the stem, it does not apply to the petiole, where the excitation seems to travel from cell to cell Sir J C Bose arrives at the conclusion that the process of transmission is the same in both stem and petiole, that it is not physical in either, but is wholly physiological, a wave of protoplasmic excitation just as it is in the nerve of the animal

The experimental evidence upon which his conclusion is based is both negative and positive The author failed, after many attempts, to repeat the experiment upon which the transpiration-current theory depends that is, to observe the transmission of excitation from one piece of stem to another connected with it by a glass tube containing water Further, if the physical theory be true, it is obvious that the velocity of the transmission of excitation and that of the transpiration-current must be the same, but it was found that the former is far greater than the latter

On the positive side, Sir J C Bose observed that transmission in Mimosa was affected experimentally in the manner well known in animal nerve For example in both the velocity of transmission is increased by rise of temperature and by desiccation Again, on passing a moderately strong electric current (6 volts) through a length of the stem, the effect at "make" of the current was observed, by the fall of adjacent leaves in one direction, to be stimulation at the cathode, on breaking the current, stimulation was induced at the anode, evidenced by the fall of leaves in the opposite direction It was further demonstrated that transmission is arrested by an electrotonic block, that is, excitation cannot travel along a tissue through which a constant electric current is being maintained These results, obtained equally with stem and petiole, go to prove that excitation is transmitted in the plant in essentially the same manner as it is in the nerve of the animal

The remaining sections of the paper deal mainly with anatomical details The conclusion is reached that the phloem is the tissue that conducts excitation, not the sieve-tubes, but the elongated tubular cells of which the phloem mainly consists Moreover, evidence is adduced that a strand of these tubular cells occurs also on the inner surface of each xylem-bundle, and this strand is termed the "internal phloem" The results of anatomical observation agree with those of physiological investigation by means of the electric probe When the probe was inserted gradually into the petiole, maximum negative galvanometric deflexion was manifested when it penetrated the external phloem and again when it reached the internal phloem

The paper concludes with a comparative study of the pulvinus, from which it appears that the more excitable the pulvinus the more deeply does the protoplasm of its contractile cells stain with safranin it also reduces osmic acid, indicating the presence of a readily oxidisable substance, not a fat or a lipoid, which is probably concerned in developing the energy required for the active contraction of the organ

Earthquake Investigation in the United States

AS already mentioned in NATURE of April 25, p 615, an act of the United States Congress was approved early this year enacting "that the Coast and Geodetic Survey is hereby authorised to make investigations and reports in seismology, including such investigations as have been heretofore performed by the Weather Bureau" The reasons for the change and the work that it is hoped to accomplish are given in an excellent popular account (U S Coast and Geodetic Survey, Serial No 304, price 10 cents) by Mr E Lester Jones, the director of the Survey

In 1899, the Coast and Geodetic Survey developed a plan for the magnetic survey of the United States, and five observatories were established in places that proved to be admirably adapted for earthquake observations Of these places—Porto Rico, Maryland, Arizona, south-east Alaska and Hawaii—three are in major earthquake zones and one near such a zone As in other places, it was found that the magnetic instruments recorded certain kinds of earthquake waves, and they were supplemented by seismographs which have been in action for more than twenty years In 1906, after the Californian earthquake, the Weather Bureau installed seismographs at Chicago, Washington and Northfield (Vt), but, after a time, it was found that seismological investigation, and especially the instrumental part, did not fit in well with the work of the Weather Bureau, nor did the Coast and Geodetic Survey feel justified in attending to seismographs merely as an adjunct to its magnetic work Accordingly, by agreement of the Secretaries of Agriculture and Commerce, Congress was asked to enact the legislation referred to above

In several ways, the ordinary work of the Coast and Geodetic Survey is adapted for earthquake investigations The routine of operating magnetic

instruments, with the necessary attention to details which such precise instruments require, gives the observers the qualifications needed to get the best results from high-grade seismographs The Survey maintains tidal stations at numerous points along the coast with continuous record by automatic gauges Most important of all is the fact that the changes in the horizontal or vertical position of places in the central area of an earthquake can be determined only by precise triangulation and levelling Such work by the Coast and Geodetic Survey has been in progress for three years in California, for it is understood that not only have changes occurring at the time of earthquakes to be considered, but also movements of large areas as a whole between earthquakes C D

University and Educational Intelligence

A SUMMARY of important State Laws relating to education enacted in 1922 and 1923 has been published by the United States Bureau of Education in Bulletin 1925 No 2 In the year 1923 laws were passed in twenty-two States prescribing instruction in the public schools in the constitution of the United States the duties of citizenship or "Americanism," which is defined (North Carolina) as including (*a*) respect for law and order, (*b*) character and ideals of the founders of the country, (*c*) duties of citizenship, (*d*) respect for the national anthem and the flag, (*e*) a standard of good government, (*f*) constitution of N Carolina, (*g*) constitution of the United States In Florida, teachers and professors in State institutions were forbidden to teach atheism or agnosticism or to teach as true Darwinism or any other hypothesis that links man in blood relationship to any other form of life

THE London County Council has again arranged numerous lectures for teachers during the winter, and a descriptive handbook has been prepared (The County Hall, Westminster Bridge, S E 1) The lectures scheme is now self-supporting and last year s attendance approached 14 000 Any person engaged in teaching in London or Middlesex is eligible for admission at fees which average less than 1*s* a lecture, out-county teachers are admitted at fees 50 per cent higher Among the lectures which will interest readers of NATURE are the following —Special single lectures by Prof J Arthur Thomson on "Visualising in Nature Study," by Sir William Bragg on "Quartz," by Sir Sefton Brancker on "Aviation in the British Empire," Dr A S Russell on "Radio-activity" Prof Leonard E Hill on "Sunlight and Open-Air Classes," and by Mr Richard Kearton on 'Wild Life round London" Courses will be given by Prof T P Nunn on science for the elementary school, by Dr L F Bates on modern theories of magnetism, by Mr J W Bispham on science-teaching in junior technical schools, by Prof Cyril Burt on mental tests, and on experimental psychology and its bearing upon education In mathematics there will be three courses dealing with the teaching of mathematics of different grades, while Prof H Levy is giving a course on the work of the mathematical laboratory Geography is represented by courses on physical, regional and historical geography on the teaching of local geography and on practical work in geography These lectures are valuable in that they enable teachers to keep in touch with modern developments in their respective subjects

THE City and Guilds of London Institute has issued as an addition to its report for 1924 (the forty-fifth annual report since the incorporation of the Institute) a report to the University of London by the University s Visitor Sir Alfred Ewing, on the research, teaching, and equipment of the City and Guilds (Engineering) College The Visitor found much to admire and very little to criticise His observations relate to matters of such fundamental importance, and they are supported by lucid statements of principles so generally applicable, that they deserve attentive consideration by other engineering schools Referring to the danger, to which all engineering schools are exposed, of overloading the course with a study of technological method and detail which takes up the time and attention that should be given to matters which are far more educative and, in the long run, of greater professional importance, Sir Alfred Ewing remarks that it 'tends to become more acute where a school is divided into departments which may tempt a student to specialise prematurely and where in each department there is a lavish equipment of large-scale engineering plant' He adds, however, that the course at the City and Guilds College, where the laboratories are extraordinarily spacious and splendidly equipped, is, on the whole, well balanced Among the novel and interesting features of the laboratory work are testing machines of a new type designed by Prof Dalby A large section of the laboratory is not in use at present on account of the difficulty of paying rates on it The technological examinations conducted by the Institute in Great Britain and Ireland were held at 297 centres, and the number of candidates examined was 8578 In addition, 1326 candidates were examined in the Dominions Overseas (chiefly New Zealand) and India

THE League of Nations (Information Section) sends us a report on the "Instruction of Children and Youth in the Existence and Aims of the League' which is to be submitted to the Sixth Assembly opening in Geneva on September 7 The report shows that the League s propaganda has led to a vast amount of activity on the part of government departments, national associations of teachers, and other national and international organisations in the preparation of special pamphlets and magazine articles, the provision of special lectures and courses of instruction, the organisation of conferences, exhibitions, schemes for awarding special diplomas and badges, inter-scholar correspondence, exchange of students and international visits, and obtaining travelling facilities and collective passports The Sixth Assembly is to consider, *inter alia*, a proposal that the League's Committee on Intellectual Co-operation should invite all professors and teachers to collaborate by preparing and distributing to all scholastic institutions literature instructing the young in the aims of the League The effects of all these activities in different countries will depend to a great extent on the place already held in the national system of education by instruction in the duties of citizenship and practical exercises in those duties Where, as in the United States, these are commonly recognised as an essential part of primary education, the attempt to establish a new loyalty to the ideals of the League may find a safe foundation of patriotism on which to work, but when this foundation is lacking the results may be unfortunate In Great Britain, at any rate, it may well be asked whether the teaching of loyalty to that older league of nations known as the British Empire should not take precedence "The internationalism that denies the worth of patriotic preference," says Wickham Steed in the preface to his reminiscences, "is as debilitating as is unqualified scepticism in regard to philosophical or religious belief

Early Science at Oxford

September 9, 1684 A letter from Mr Creech, dated from Worcester, September the 4th, was read, it gave an account of a Woman in Worcester, who, for these twenty years last past, has every Sunday had a Convulsion Fit, and at no time else, unless she puts both her feet over her threshold, which if she does, a fit certainly seizes her the case of this woman is drawn up by ye learned Dr Cole, Physitian at Worcester, and was comunicated to severall of the physitians in Oxford about a year and a half since

Mr Francis Davenport's account of the Tides at Tunquin and Mr Halley's Theory of those Tides, were read, and will be printed very suddenly

Dr Plot communicated an Instrument made by Mr Bard of Fretwell, for ye better æstimating ye increase, and decrease, of ye weight of oil of vitriol exposed to ye open air ye Doctor promises us to make use of it, and give ye Society an account of ye success

Dr Plot also communicated an account of ye weather here at Oxon during ye last month, and an abstract of a letter from the Reverend Dr Thomas Smith, now at London, who says, that a Naturall History of Scotland is lately printed at Edinborough by Sir Robert Sibbald

The Doctor further communicated to the Society that, in a visit made by himself to ye men of Siam lately come into England, he received from them a present of a black lead pen of their country, and a nut whose kernell is call'd Areka, which has a smart aromatick tast, and is said to be purgative

He understood from them, that their alphabet, and numerall figures, were ye same with those of ye Indians

Dr Smith shewing himself very ready to oblidge ye Society, by proposing to those men of Siam any quæries which shall be sent him hence, it was offered by Mr Bernard, that ye Doctor be desired to discourse with them on ye severall heads of Dr Plot's sheet of enquiryes

There being some discourse concerning Barometers, particularly it being affirmed, That a candle placed near ye upper and empty part of ye Tube will make ye quicksilver descend, it was proposed by Mr Bernard, that tryall be made, whither spirit of hartshorn, applied to the top of ye Tube, will cause ye quicksilver to ascend?

Mr Præsident proposed that enquiry be made whether the quicksilver arises and falls in old barometers, to as many degrees, as it did in ye same barometers, when they were new? In one which he for many years made use of, he has found it does not

Dr Plot presented ye Society with a peice of heavy wood from Jamaica, called *Kicongo*, 'tis of a smell like *Enula Campana* Some Experiments will be tried on it very suddenly, and an account of them brought in to the Society

The Doctor, haveing finished his discourse *de Origine Fontium*, was, at this meeting, desired by ye Society, to communicate it to them, and begin reading it the next week

The Society then tooke into consideration the enlarging of their Correspondence, for ye effecting of which they concluded, that some attempts be made for ye settling a Correspondence in Scotland, in like manner, as it is now carried on between ye Royall Society and that of Dublin, and this of Oxford, in order whereunto, it was ye most humble request of this Society to Mr President to take on him ye trouble of writing to the Heads of ye Universitys in Scotland concerning this affair

Societies and Academies.

London

Institute of Metals (Autumn Meeting, Glasgow), September 2 —J H **Andrew** and Robert **Hay** Colloidal separations in alloys The β constituent may break down into colloidal α and colloidal γ, and upon submitting these to an electrical current, the colloid is destroyed and the crystalline phase begins to make its appearance The ageing of duralumin may be due to the deposition of the magnesium compound in the colloidal form, when the increase in hardness would be due rather to the fineness of state of division of the separating phase than to its specific properties —John S **Brown** The influence of the time factor on tensile tests conducted at elevated temperatures With non-ferrous alloys there is a critical temperature condition, above which the rate of application of the load has an important influence on the observed strength This time factor tends to lose its effect when the rate of loading is kept below 1 ton per sq in per day, and this value is consequently put forward as of basic importance in such investigations —R B **Deeley** Zinc-cadmium alloys A note on their shear strengths as solders A substitute for brazing spelter was required for the motor-cycle industry The working temperature of the substitute solder had to be below that likely to promote coarse crystallisation of the hard-drawn steel tubing of the frame, and the melting point had to be sufficiently above the enamel stoving temperature (about 180° C) for joints made with the alloy not to fail during enamelling Zinc-cadmium alloys in pure shear show the strongest alloy to be near the eutectic composition This alloy is considerably stronger than tinman's solder, 8 tons/sq in compared with 4 tons/sq in —J W **Donaldson** Thermal conductivities of industrial non-ferrous alloys The thermal conductivities of 70 30 brass, high tensile brass or manganese bronze, Admiralty gunmetal, ordinary gunmetal, bearing phosphor bronze white bearing metal, and monel metal are low, ranging from 0 067 for monel metal to 0 242 for 70 30 brass Increasing the temperature increases the conductivities The alloys of tin and copper have a lower conductivity than those of zinc and copper, while nickel lowers considerably the conductivity of an alloy containing it —Marie L V **Gayler** On the constitution of zinc-copper alloys containing 45 to 65 per cent of copper In an equilibrium diagram, no change in microstructure of alloys consisting wholly of the β constituent could be detected —J L **Haughton** and W T **Griffiths** The β transformations in copper-zinc alloys The change of resistivity with temperature was determined for some alloys containing from 46 to 63 per cent copper Above 55 per cent copper the β-transformation temperature is 453° C, between 55 per cent and 51 per cent copper it takes place at temperatures rising from 453° C to 470° C with less than 51 per cent copper the transformation temperature is 470° C These data are opposed to the theory that this is a eutectoid transformation The specific resistances at room temperatures were also measured after annealing just above the transformation point The resistance falls rapidly as the copper decreases from 61 per cent to 53 5 per cent and less rapidly to about the 50 per cent copper alloy it rises steeply from this point with further decrease of copper content Thus the two boundaries of the field at room temperature occur at 50 0 and 53 5 per cent of copper —C H M **Jenkins** The physical properties of the copper-cadmium alloys rich in cadmium Alloys containing up to 5 per cent of copper in the

cast, rolled and annealed states, were used The effect of even a small addition of copper to cadmium is to cause the formation of a second constituent $CuCd_3$ this increases the tensile strength and Brinell hardness and prevents the grain growth of cadmium on annealing Additions of more than 3 per cent of copper do not materially improve the mechanical properties of cadmium owing to the presence of too large a proportion of the brittle compound

PARIS

Academy of Sciences, July 20 —A **Haller** and R **Cornubert** The constitution of the dimethylcyclopentanone and the dimethylcyclohexanone obtained by alkylation by means of the sodium amide method —Nicolas **Kryloff** A method based on the principle of the minimum, for the approximate integration of differential equations —R A **Fisher** The solution of the integral equation of V Romanovsky —W **Stepanoff** Some generalisations of nearly periodic functions —Rolf **Nevanlinna** A theorem of unicity relative to uniform functions in the neighbourhood of an essential singular point —N **Lusin** The use of the diagonal of Cantor —R **Roudaire-Miegeville** A new grapho-mechanical determination of systems of real or imaginary solutions of algebraical equations —J **Seigle** Tests of mild steel by combined stresses —Marcel **Peschard** The magnetisation of ferro-nickels (paramagnetic properties) —G **Athanasiu** The sensibility of actinometers with electrodes coated with silver iodide and copper oxide —G **Bruhat** and M **Pauthenier** A theoretical study of 320 $m\mu$ of carbon disulphide —R de **Mallemann** The calculation of rotatory power starting with the molecular structure —S Pina de **Rubies** The arc spectrum of scandium The scandia was extracted by G and P Urbain from Madagascan thortveitite, transformed into the acetylacetonate and the latter purified by repeated sublimations in a vacuum at 190° C, followed by recrystallisation from absolute alcohol A table of wave-lengths and intensities is given —Gabriel A **Rousseau** Method for instantaneous photography in colour Three films are superposed the first receives a slow ordinary emulsion, the second an emulsion sensitive to the yellow and green, and the third an emulsion sensitive to the yellow and red Details of the preparation of the sensitised films are given The photograph is taken without a screen, working as with an ordinary plate —Adolphe **Lepape** The radioactivity of some cold springs in the Bagneres-de-Luchon region and on its origin —Mlle Germaine **Cauquil** Study on viscosity and surface tension during esterification —**Pariselle** and **Laude** The magnesia carried down by alumina in ammoniacal media The presence of a large excess of ammonium chloride prevents co-precipitation of magnesia with aluminium hydroxide —Pierre **Bedos** A new racemic menthone and the two corresponding stereoisomeric menthols —R **Locquin** and R **Heilmann** The decomposition of the pyrazolines by spontaneous oxidation The spontaneous oxidation of pyrazolines by air is complex and gives either a saturated or an unsaturated ketone, together with basic substances of high boiling point, so far not identified —E E **Blaise** and Mlle M **Montagne** The transformation of the dialkylcyclohexenones into dialkylbenzenes Methylethylcyclohexenone heated in a sealed tube on the water bath with a saturated aqueous solution of hydrobromic acid gives *o*-methylethylbenzene The reaction appears to be of a new type —I **Pouget** and D **Chouchak** The radioactive mineral waters of Guergour, Algeria —Mlle H **Popovici** The formation of essential oils —Raoul **Combes** Does light exert a direct action on the decomposition of chlorophyll in leaves in the autumn? The results of the experiments described are not in agreement with Wiesner's hypothesis, and light does not appear to be a direct cause of the disappearance of chlorophyll from leaves in the autumn —Andre **Mayer** and L **Plantefol** The equilibrium of the cellular constituents and form of oxidations of the cell Imbibition and respiratory types in reviviscent plants —H **Colin** and A **Grandsire** The mineralisation of green leaves and of chlorotic leaves —P R **Bohn** The presence of crystals of calcium oxalate at the surface of certain Caryophyllaceæ — — **Kuhner** The development of *Lentinus tigrinus* —Emile **Saillard** The method of Clerget Coefficients of inversion Inversion at the ordinary temperature for 28 hours or at 70° C (11 minutes) gave the same results The inversion coefficient varies slightly with the concentration of the saccharose figures are given for coefficients of solutions from 4 to 16 per cent of saccharose —Ch **Brioux** and J **Pien** The use of the quinhydrone electrode for the determination of the P_H of soils This method is advantageous from the point of view of rapidity and simplicity, but there are divergences between the results obtained by the quinhydrone and hydrogen electrodes at present unexplained —M and Mme A **Chauchard** The law of excitability of the electrical apparatus of *Torpedo marmorata* —A **Rochon-Duvigneaud** E **Bourdelle**, and J **Dubar** An attempt at the determination of the anatomical binocular visual field of the horse —F **Vles** and A de **Coulon** Relations between the experimental displacement of the muscular isoelectric points and the evolution of grafted tumours —L **Hugounenq** and J **Loiseleur** The superposition of the phenomena of dissociation and elective adsorption in the proteolytic diastases —E **Kayser** and H **Delaval** Radio-activity, nitrogen fixers and alcoholic yeasts In an earlier communication it was proved that the addition of a radioactive mineral to the ordinary nutritive medium stimulated the action of Azobacter and the increase varied with the strain of the organism These results are now supplemented by varying the proportion of the radioactive mineral, by ascertaining the influence of repeated use, and by determining the ratios between sugar used up and nitrogen combined The effect of the radioactive mineral on alcoholic fermentation has also been studied —Jean **Bathellier** The period of the determination of the castes in *Eutermes matangensis* —Ch **Champy** The disharmony of the secondary sexual characters and the proportionality of the sexual glands in insects —G **Ramon** The production of antitoxins —F **Dienert** Contribution to the study of activated sludge —Georges **Bourguignon** The physio-pathological signification of Babinski test —C **Levaditi**, A **Girard**, and S **Nicolau** The treponemicidal action of gold and platinum —George **Truffaut** and N **Besszonoff** The predominance of the activity of anaerobic nitrogen fixers in the soil

CALCUTTA

Asiatic Society of Bengal, August 3 —H L **Chhibber** Microscopic study of the old copper slags at Amba Mata and Kumbaria Danta State, N Gujarat, India The sites are two old metallurgical centres more than six hundred years old The slags are mostly the remains of low grade minerals of the oxidised zone no great depth below the surface was worked —N G **Mazumdar** Dacca image inscription of the reign of Lakshmanasena Iconographically this is an important image as representing an otherwise unknown type of Chandi —B S **Guha** Preliminary report on the anthropometry of the Khasis Measurements were made on inhabitants of Cherapunji and neighbouring villages Special attention was given to the measurements of

the face , there is difficulty in determining the shade of colour of the skin of brown people —Hem Chandra **Das-Gupta** Palæontological notes on the Panchet beds at Deoli, near Asansol Descriptions of three specimens (1) the carapace of a brachyurous crab (?), (2) a stegocephalian cranium , (3) a reptilian coracoid The second specimen is tentatively identified as belonging to *Pachygonia incurvata*, Huxley, the third specimen, similarly to *Epicampodon* (*Ankistrodon*) *indicum*, Huxley The first specimen differs from the only two described genera of Triassic brachyurous crabs —Sukumar **Sen** Notes on the employ of the cases in the Kāthaka-samhitā An analysis of the use of the cases as exhibited in Leopold von Schroeder's edition, published from 1900 to 1910, shows a marked difference in language and idiom as compared with other Vedic prose texts

MELBOURNE

Royal Society of Victoria, July 16 —Gerald F **Hill** Termites from the Ellice Group The only species of termite hitherto recorded from these islands has been confused with an American species until recently supposed to have been introduced into Hawaii The species is identical however, with an imperfectly known Samoan insect —*Calotermes samoanus* Holmgr —and not with any described Hawaiian or American form *Prorhinotermes inopinatus* Silv hitherto known only from Samoa, is now recorded from the Ellice Group Both species are destructive to coconut palms —C E **Eddy** The *L* absorption limits of lutecium, ytterbium, erbium, and terbium The *L* series critical absorption wave-lengths were measured relative to tungsten *L* lines as standards A metal X-ray tube, with a thin window, and capable of being operated at 30 kilo-volts and 30 milliamperes, was constructed, and used in conjunction with a low pressure spectrometer The values of the critical absorption wave-lengths were as follows

	L_{I}	L_{II}	L_{III}
Lutecium	1136 21 X U	1194 0 X U	1337 5 X U
Ytterbium	1176 4	1238 14	1382 64
Erbium	1265 5	1335 60	1479 19
Terbium	1417 0	1499 4	1644 2

—W J **Harris** Victorian graptolites (new series), Pt 2 Four graptolites are described, three being new species, and one of these representative of a new family Atopograptidæ (*fam nov*)—a biserial form with thecæ with extroverted apertures , represented by *A woodwardi, nov* , from Bendigo East *Didymograptus nodosus, sp nov* , and *Cardiograptus crawfordi, sp nov* , from Bendigo East and Gisborne (Victoria) These three species are from Upper Darriwil beds near the top of the Lower Ordovician —W M **Bale** Further notes on Australian hydroids, V This paper describes *Sertularia nana* and *S gracillima* new species, and gives a detailed account of *S furcata* Trask, a common Californian species recorded doubtfully as Australian A Sertularella, originally referred to *S polyzonias*, is now described as *S peregrina n sp* It is most nearly related to *S mediterranea* Hartlaub *Plumularia delicatula* Bale is given a new name—*P Wilsoni*—on account of the priority of *P delicatula* Busk (an Aglaophenia) A variety of *Aglaophenia divaricata* Busk, formerly referred doubtfully to *A acanthocarpa* Allman, is named var *Briggsi* —Irene **Crospin** The geology of Green Gully, Keilor, with special reference to the fossiliferous deposits Green Gully is near the Keilor township, ten miles from Melbourne The rocks consist of a succession of cainozoic sediments overlying the older basalt which rests on the Silurian bed-rock The lowest of these cainozoic sediments is a moderately deep-water limestone which passes into a fossiliferous ferruginous rock, both of which are of Miocene (Janjukian) age The limestone is characterised by a rich growth of calcareous alga (Lithothamnium) and by the abundance of the discoidal tests of several species of Lepidocyclina The ferruginous bed contains a large assemblage of molluscan fossils, mainly in the form of casts, as well as some corals which show close relationship with the Janjukian fauna of Table Cape, Tasmania, some species being restricted to the two localities —Frederick **Chapman** Geological notes on Neumerella and the section from Bairnsdale to Orbost Fossils are of Miocene (Janjukian) age and were collected at Neumerella during the construction of the Bairnsdale to Orbost line 150 species of fossils are recorded and notable additions made to the lists of fossil fishes, ostracoda, mollusca, polyzoa, and foraminifera The fossil bands are seen in the cuttings with remains of cetaceans and sharks' teeth , there are intercalated marly limestone layers, and evidence of local crumpling and faulting in the Janjukian Large volutes and Nautilus frequently occur in the yellow marls as casts, and many are encrusted with a crystalline coating of calcite, probably representing the dissolved shell

ROME

Royal Academy of the Lincei, June 21 —B **Grassi** Contribution to the study of the biology of *Anopheles superpictus* —B **Longo** and A **Cesaris-Demel** The possibility of anaphylactic sensitisation in vegetable organisms —S **Saks** Integration of the polynomials of Stieltjes —Bruno **Finzi** The motion of the boomerang —Luigi **Carnera** The new Washington catalogue of fundamental stars and the Berlin catalogue of circumpolar stars —D **Pacini** Observations on the vertical air-earth current —E **Fermi** and F **Rasetti** Effect of an alternating magnetic field on the polarisation of resonance light —E **Persico** Amplitude of the oscillations produced by a three-electrode lamp —L de **Caro** Surface tensions of gelatin solutions of different hydrogen-ion concentrations —E **Clerici** The diffusion of certain microscopic organisms of the rocks accompanying the Roman volcanic tufas —Silvio **Ranzi** The organ of sense derived from the first epibranchial placoid of Selacei

Diary of Societies

WEDNESDAY, THURSDAY, FRIDAY SEPTEMBER 9, 10, 11

IRON AND STEEL INSTITUTE (Birmingham Meeting) (at the University Edmund Street, Birmingham) —J H Andrew and R Higgins The Dilatation of Cast Irons during Repeated Heating and Cooling —M L Becker Equilibrium at High Temperatures in the Iron Carbon Silicon System —D F Campbell High Frequency Induction Furnaces —E D Campbell and J F Ross The Chromium Iron Equilibrium in Carbides recovered from Annealed 2 23 per cent Chrome Steels —A L Curtis Steel Moulding Sands and their Behaviour under High Temperatures —Prof C A Edwards and L B Pfeil The Tensile Properties of Single Iron Crystals and the Influence of Crystal Size upon the Tensile Properties of Iron —Dr C F Elam The Orientation of Crystals produced by heating Strained Iron —Dr J Newton Friend and W E Thorneycroft Ancient Iron from Richborough and Folkestone —R H Greaves and J A Jones The Effect of Temperature on the Behaviour of Iron and Steel in the Notched Bar Impact Test —L Grenet Notes on the Iron Nickel and Iron Cobalt Equilibrium Diagrams —H Kamura Reduction of Iron Ores by Hydrogen —J L Keenan Blast Furnace Practice in India, with special reference to Economy in Coke Consumption —W R Martin The Davis Steel Wheel and its Manufacture in England —J A Mathews Retained Austenite —H Frodin A New Direct Process —J H Partridge The Magnetic and Electrical Properties of Cast Iron —A Sauveur and V N Krivobok Dendritic Segregation in Iron Carbon Alloys —A Sauveur and D C Lee The Influence of Strain and of Heat on the Hardness of Iron and Steel

SATURDAY, SEPTEMBER 12, 1925

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NO 2915, VOL 116]

The Worth of Knowledge

O fret not after knowledge!—I have none
And yet my song comes native with the warmth
O fret not after knowledge!—I have none,
And yet the Evening listens

KEATS

IN the course of his presidential address to the Education Section of the British Association at the recent Southampton meeting, Mr W W Vaughan, headmaster of Rugby School, remarked that an agricultural labourer who had left school at thirteen years of age is often a better-educated man, in the best sense of knowledge, than a city clerk or other black-coated worker who had passed through a secondary school course before entering office life Those who are familiar with the countryside and farm labourers know that much truth is contained in Mr Vaughan's observation, but they know also that it is a dangerous doctrine to preach because of the excuse it gives to farmers and parents to secure the release of children from school at the earliest possible age in order to put them at work in the field It is easy to suggest that a child who leaves school for outdoor work at ten or twelve years of age may be learning more than he would in a village classroom, but this is the kind of reasoning that leads to the exploitation of child-labour, and, in Great Britain at any rate, the State has rightly decided that every child without exception, whether in country or town, must now remain at school until at least the age of fourteen years has been reached

There are, of course, many social reasons for this necessary condition, and among them is the value of discipline Knowledge itself, especially that often contemptuously called "book-learning," may, as Keats expressed in the lines from his sonnet on "The Thrush," quoted above, be of little actual worth as a means of gaining or giving delight to life, yet, like the gift of mercy, it can be twice blessed if rightly used There is one joy in seeking after knowledge and another in arousing interest in others in the beauty and promise of the new world revealed What is worth having is worth sharing, and it is because of this conviction that we continually urge support and encouragement to effort made to create and foster wide interest in scientific achievement

This is one of the objects of the British Association, and we believe that the annual meetings do much to fulfil their purpose in this respect through the publication in the newspapers of summaries of the presidential addresses, lectures and selected papers It is, however, in no captious spirit that we suggest that much more remains to be done if the service of science in modern life is to be understood through the meetings

of the Association In the first place, there should be no misapprehension as to the constitutions of the audiences for which the president's address and the addresses of the sectional presidents are intended Members of the lay public are invited to join the Association, but the presidential addresses are almost invariably unintelligible to them, and so are most of the papers There are no doubt people like the lady who said she did not understand a scientific lecture she had attended, yet she liked the sound of it, but it is scarcely the function of the Association to titillate the ears of passive listeners

We are of the opinion, however, that the addresses of the president and of the sectional presidents are better read than heard, and on this account we are glad that they are again available in volume form [1] The first part of Prof Lamb's presidential address deals with the absorbing topic of the nature and purpose of science in general, and we hope that it will be widely read and discussed, for such remarks, so admirable in form and substance, not only provide scientific workers with justification for the faith which is in them, but also tend to "clear the air" of any lingering feeling of hostility between them and those whose labours are purely humanistic The addresses of the sectional presidents cover a very wide field, almost the whole gamut of the sciences Many of them deal mainly or exclusively with recent advances in specialised departments, others, like those on engineering and anthropology, are throughout historical, and again others, like the addresses to the educational and economic sections, discuss problems which are of perennial interest In every case the standard attained is high, the contribution notable, and if we have any adverse criticism to make, it is that, from the point of view of the lay reader, too many of the addresses are concerned with specialised and recondite topics to the exclusion or subordination of matters which are of more obvious interest and importance, in other words, they may appear dull to the average man

The meetings of the British Association are most useful in bringing together workers in many branches of science In recent years the institution of joint discussions on border-line subjects has increased their utility, and of late there has been a noticeable levelling-up in the scientific value of the papers presented, all of which is to the good The problem, therefore, consists in realising a harmonious balance between the requirements of the specialist and those of the lay public It will, we believe, be generally admitted that addresses and papers should not, as a rule, resemble those which are given at ordinary meetings of specialised societies

[1] The Advancement of Science, 1925 London British Association, Burlington House W 1 Price 6s

the treatment should be broader and more in touch with human welfare—not necessarily material welfare

From this point of view, some of the addresses and papers contributed to the recent meeting are open to criticism About one-half of the addresses printed in the annual volume are obviously written by the specialist for the specialist Although subjects relating to education (upon which nearly every other man claims to speak with authority) and to economics lend themselves more readily to popular treatment than others, it has been repeatedly shown that even in very recondite branches of science it is possible to introduce matter which appeals to the man of average intelligence and education As examples in point, we may refer to the addresses given this year to the physiological and psychological sections The physiology of muscular exertion and the theory of intelligence do not at first sight appear inviting topics to the non-specialist, but the manner of treatment as well as the matter treated secured in these cases extended notices in the daily papers Prof Parks' address on the cultural aspects of geology was also framed in a manner likely to appeal to a wide audience We do not, of course, wish to plead for a stereotyped form of presentation, and we are well aware of the great difficulties inherent in popular exposition, but we do urge that the interests of the Association would be better served if greater use were made of its unique opportunities for securing the infiltration of scientific learning into all classes of the community

Possibly the specialisation of scientific work must prevent the proceedings of the sections from making more than a sectional appeal If this be so, then the Association must be regarded chiefly as a professional organisation, like the British Medical Association and similar bodies, neither desiring nor expecting members of the general public to attend its meetings Even then, we urge that more serious attempts should be made to improve both literary and oral exposition in presenting papers We plead for a style of composition and exposition suitable at least for a general scientific audience, even if the lay public is left out of account It is surely a reflection upon scientific training that so few who represent it are able to address a public or any other audience in a manner which will command attention or stimulate interest

A few lecturers of this kind are available, and the Association does its best to secure them for the public lectures delivered to citizens, and to children, at each annual meeting These lectures are not intended for members of the Association, and arrangements for them are in the hands of the Local Executive Committee In these days of many kinds of entertainment and obtrusive advertisement, it is obvious that

wide publicity should be given to the citizens' lectures if good attendances are to be secured This was not done at Southampton, with the result that the attendances at both these lectures and the children's lecture were far smaller than the lecturers or their subjects merited Any good lecture agent would have secured large audiences for these lectures if they had been business undertakings, but as they were not, very few people in the town or neighbourhood were aware of them This is not the way to further the purpose of the Association "to obtain more general attention for the objects of science"

The History of Telephony

The History of the Telephone in the United Kingdom By F G C Baldwin Pp xxvi+728+75 plates (London Chapman and Hall, Ltd, 1925) 42s net

THIS large book on the history of the telephone in the United Kingdom gathers together in a single volume an immense amount of valuable historical research on the development in Great Britain of one of the epoch-making inventions of electrical science The invention of the magneto-electric telephone and the reproduction by it of articulate speech at a distance is a striking example of the solution of a technical problem, long recognised as possible of solution, attacked by several inventors with very little success, yet finally accomplished by a stroke of genius in the very simplest manner

The speaking telephone, far more than many other electrical inventions, may be credited to a single inventor, in that Alexander Graham Bell was the first to discover a method, imperfect though it was, of translating the changes of air pressure constituting speech wave sounds into corresponding changes of electric currents in a line wire, and the conversion of them back into sound waves at the receiving end This use of what was then called an undulatory current in a circuit never completely opened made possible the electric transmission of speech as compared with the transmission of mere musical sounds Like many other inventions, Bell's success came as a kind of accident in the manipulation of an appliance called a harmonic telegraph which was not originally intended or hoped to function as a speaking telephone Mr Baldwin sketches in brief outline in his first chapter the stages by which Bell was thus led to success

The remarkable thing about the Bell magneto telephone, with its steel diaphragm, having such a limited number of modes of vibration, is that it should be able to transmit intelligible speech sounds at all It is probable that a large part of its success depends not so much upon its own intrinsic powers as upon the wonderful ability of the human ear to guess from a mere suggestion of a speech sound the intellectual meaning which that sound is intended to convey The true air wave-form, with its complicated outline, is in fact very imperfectly reproduced by the telephone receiver diaphragm, but a mere hint enables the trained ear to interpret it

Bell's invention, though effective as a receiver, was a very ineffective device as a transmitter, and if it had not been supplemented by the invention by Edison of the carbon transmitter, and by Hughes of the microphone, it is highly improbable that it would have fructified into practical utility or even passed beyond the stage of a scientific curiosity The combination, however, of the variable resistance or microphonic carbon transmitter and the induction coil as a means of translating sound-wave motion into electric current variation, together with Bell's magneto-receiver for effecting the reverse transformation, gave a completely practical and simple solution of the telephone problem

In his second chapter Mr Baldwin describes the early operations and subsequent union of the Bell and Edison inventions and the early stages of invention in connexion with the evolution of a telephone exchange But for this latter conception, which originated in America, the use by the public of the electric telephone would have been extremely limited The pioneer work of the original Bell and Edison Telephone Companies in London, in establishing rudimentary telephone exchanges, is described by Mr Baldwin in his second chapter, and also the story of the initial litigation between the Companies before the United Telephone Company was formed

Chapter iii opens with an account of the important litigation started by the Crown against the United Telephone Company to enforce against it the rights gained through the Telegraph Acts of 1863, 1868, 1869, under which the State purchased for about 10 million sterling the business of the pioneer electric telegraph companies These original telegraph companies conducted their operations with diverse kinds of signalling instruments, and before long there arose a movement for "nationalising," as it is now called, the new methods of intercommunication In order to prevent the Government monopoly being infringed by the possible invention of new types of electric telegraph, the Acts were drawn in such general terms that, when the telephone inventions made it possible to establish commercial exchanges worked for the convenience of "subscribers," the question was before long raised by Post Office officials, alarmed about their monopoly, whether the telephone was a telegraph within the meaning of the Acts

The case was tried by Mr Baron Pollock and Mr Justice Stephen in November 1880 and decided against

the Company. Unfortunately, the case was never taken to the Court of Appeal or to the House of Lords for confirmation or reversal. The directors of the Telephone Company, doubtful of the issue and perhaps reluctant to dissipate their available funds on further litigation, accepted a proposal of the Post Office that they should bow to the decision of the Court of First Instance and take a licence from the G.P.O. for a term of years, and the payment of a royalty of ten per cent. of their gross receipts from all exchange business carried on within five miles of the General Post Office, London. Thus it came to pass that the fetters of State control were riveted on the limbs of the new industry; and in the following thirty years the General Post Office was able to extract from the telephone more than a million sterling in the form of royalties, for which the State had given no equivalent of actual value.

The important question, from the point of view of the general public, is whether it is to the advantage of the community that a business so technical, and involving the necessity for so much invention and scientific knowledge, should be under the control of the State at all. Arguments can be given for and against the contention. Government departments certainly do not provide a congenial soil in which enterprise, invention, or economical commercial progress can flourish. No young man entering a Government department finds that originality or initiative is encouraged or that it tends to fame and fortune for himself; in short, it does not pay, and hence he soon settles down to a steady but slow-going officialism. Moreover, Government departments are subject to the changes of policy incidental to successive administrations. Thus it has come to pass that succeeding governments in Great Britain have played with the telephone as a cat plays with a mouse. The dual control, partly by the G.P.O. and partly by a limited company, was for years disastrous to progress.

The history of the telephone in Great Britain is therefore in great part a revelation of Government ineptitude, and supplies solid reasons against that nationalisation of technical industries with which present-day socialists are so enamoured. It is sufficiently suggestive that none of the great inventions in connexion with telephony have originated with British Government officials. They did not invent the telephone itself, or originate the telephone exchange, or the dry core cable, loading coil, uniformly loaded cable, phantom circuit, automatic telephone exchange, or the thermionic telephone repeater. All these important inventions originated with private inventors and came to us mostly from the United States, where the telephone is not under Government control but is a private enterprise. Furthermore, the ideas of scientific men such as the late Mr. Oliver Heaviside or Prof. Silvanus Thompson who suggested improvements, were not followed up but even resisted by official electricians, and telephonic invention in Great Britain languished accordingly.

Returning, then, to Mr. Baldwin's book, we find that in the following twenty chapters he gives us an excellent account of the development of the great inventions which have been enumerated above. The gradual evolution of the telephone switchboard is illustrated by numerous valuable diagrams, and the replacement of the human element in it by the fully automatic exchange is outlined. The completely automatic telephone exchange by which, without any human intervention, a subscriber calls up another, finds out if he is already engaged, if not, converses with him, and finally switches himself out, is one of the most marvellous pieces of mechanism which the human mind has ever devised. Its elaboration has been due to many clever brains directed to a surpassingly difficult problem. The G.P.O. has now established in Great Britain a considerable number (about 25) of these automatic exchanges on various systems.

In the chapter on long-distance transmission, Mr. Baldwin only devotes a paragraph or two to another invention of cardinal importance, namely, the thermionic repeater, which has enabled a vast extension of telephonic range to be obtained. Suffice it to say that telephone electric currents are weakened by travelling along aerial lines or in cables. But a device called a thermionic repeater, which is a development of the thermionic valve invented by the present reviewer, is employed to reinvigorate these currents and send them on a farther stage with fresh energy. The importance of this invention is that it enables wires of smaller section, and therefore cheaper, to be employed. If the trunk telephone lines of Great Britain had to be relaid, it would be possible to save hundreds of thousands of pounds in mere cost of copper.

Taking the volume as a whole, we can say that Mr. Baldwin has given us a very readable and interesting history of the telephone in Great Britain. The book contains a large number of illustrations showing the development of various appliances, whilst much useful information in the form of tabular statistics is contained in the appendices. A good index completes a book which will certainly be highly appreciated by all telephone men and those who have to explore the history of any part of the subject. Lastly, a short introduction by Mr. Frank Gill, who was for eleven years engineer-in-chief of the National Telephone Company, and intimately acquainted with the history as well as technique of the subject, gives the reader an assurance of the trustworthy character of the history so well presented.

J. A. FLEMING.

The Contact Process for Oleum Manufacture

The Manufacture of Sulphuric Acid (Contact Process) By F D Miles ("The Manufacture of Acids and Alkalis," by Prof George Lunge Completely revised and rewritten under the editorship of Dr A C Cumming Vol 4) Pp xv+427 (London and Edinburgh Gurney and Jackson, 1925) 36s net

IN the realm of pure chemistry, few better examples than the chemical change between sulphur dioxide and oxygen can be selected to illustrate the general principles involved in gas reactions, whilst its value in the elucidation of the mysterious influences at work in the field of catalysis cannot be overestimated The fundamental features of the contact process, as we now know it, were first described by Peregrine Phillips, a vinegar manufacturer of Bristol, in his patent of 1831, and to him belongs the credit of making the original scientific discovery and of realising its commercial possibilities Nevertheless, no practical success had been attained when, in 1868 to 1872, the synthetic production of alizarin removed one of the chief reasons for this slow development—the absence of a market for fuming sulphuric acid

At this time the sole maker of fuming acid was Baron Stark in Bohemia, the process used being substantially that of Basil Valentine (born 1394)—the decomposition of ferric sulphate obtained from "copperas-slate" No wonder that chemists turned their attention to the production of fuming acid in other places and by other methods The publication in 1875 of a paper by Clemens Winkler, professor in the School of Mining at Freiberg, marked the beginning of most important developments He recommended platinised asbestos as the catalyst in preference to platinised pumice or porcelain, and, in order to obtain the best results, postulated the necessity for having the sulphur dioxide and oxygen present in the stoichiometric ratio necessary for acid formation The fact that for many years the latter statement was accepted and quoted by all classes of chemists shows how little attention the Law of Mass Action, enunciated by Guldberg and Waage in 1867, was receiving in 1875 Any chemist acquainted with this law could have shown the error in Winkler's conclusions by pointing to the equation of the reaction Almost on the same day that Winkler sent in his manuscript, an application by W S Squire was lodged for a British patent, embodying the joint invention of Squire and Messel The process was established at Silvertown and produced several tons of trioxide per week The loss of activity of the catalyst, due to its accumulating such impurities as flue dust, was first noted by these workers, but its sensitiveness to specific poisons such as small traces of arsenic was not known until many years later

In 1901 Knietsch gave his famous lecture to the German Chemical Society, in which he described some of the work which had been carried out in the laboratories and on the plant of the Badische Company

"This discourse," says Mr Miles, "in spite of defects and notwithstanding its many omissions, is still the most important ever recorded on the scientific and technical aspects of the oxidation of sulphur dioxide Not only had Knietsch and his collaborators examined the behaviour of platinum and other catalysts under various conditions of temperature and rate of flow of gas and supplied much-needed information about the physical properties of fuming acid and sulphur trioxide and their action on iron and steel, they had also found solutions of all the technical problems which had made difficult the use of pyrites burner-gases, abandoned the theory of Winkler, arrived at the unexpected conclusion that contact vessels require cooling and not heating, and had in general rendered the contact process so successful that it could henceforward not only produce fuming acid cheaply but actually compete with the chamber process for ordinary concentrated sulphuric acid"

Yet, prior to the War, the number of plants manufacturing oleum in Great Britain could be counted on the fingers of one hand With the outbreak of war, a large supply of fuming acid became an urgent necessity, and the existing sources were quickly supplemented by many plants of great size and varying design

Such are some of the main points in the fascinating history of the manufacture of oleum with which Mr Miles begins his excellent book on the contact process A survey of these facts fully supports the author's contention that the contact process is one of the foremost achievements of technical chemists, for undoubtedly the many difficulties that arose in the course of the pioneer work were solved more or less empirically by dint of hard work, the running of careful trials, and the gradual accumulation of data However, Mr Miles is optimistic and appreciative of the results which can and should accrue from the linking up of purely scientific and technical discovery, for, as he says, "the barriers dividing knowledge are broken down and we may hope to have in regard to the contact process in both technical and scientific aspects a body of information which from every point of view is equal to that applying to any other chemical change"

With the general treatment of the subject no one who peruses this volume can fail to be impressed The author mentions as one of his aims the avoidance of a too sharp distinction between the technical and scientific aspects of the subject In this respect he has been exceptionally successful, attaining an almost

perfect blending of the theoretical and practical considerations How complex and intriguing are the numerous factors to be considered in the formation of the trioxide and its absorption may be gauged from the chapters on the properties of sulphur trioxide and oleum, gas equilibrium and velocity of reaction, catalysis and contact mass, gas purification and absorption of the trioxide All these phases are dealt with in a lucid and authoritative manner, interposed with valuable suggestions for future research and development The last three chapters in the volume describe Grillo-Schroder plants and the Tentelew and Mannheim processes, and contain important information of practical significance Replete with excellent illustrations and nomographic charts, this volume is in every respect a noteworthy production, fully maintaining the great traditions which will always be associated with Dr Lunge's treatises W W

British Scientific and Technical Books

A Catalogue of British Scientific and Technical Books Covering every Branch of Science and Technology, carefully Classified and Indexed New edition, entirely revised and enlarged Pp xxii+489 (London British Science Guild, A and F Denny, Ltd, 1925) *12s 6d* net

THE British Science Guild performed in 1921 an extremely useful public service in issuing a catalogue of British scientific and technical books By donations from interested bodies and a number of publishers, and with the aid of what must have been a considerable amount of voluntary labour, the Guild has found it possible to issue a new edition without undue drain upon its own slender resources, and the result is eminently one upon which it may be congratulated

In this edition the terms "scientific" and "technical" and the term "book" have been broadly interpreted, with the result that it contains more than 9500 titles, an increase of nearly 50 per cent on the first edition The entries are grouped into classes corresponding with the main and recognised divisions of scientific work, each division being arranged in sections on a subject basis, the entries in each section being in alphabetical order of authors It is easier to criticise such a classification than to suggest an improvement, and it is hoped that the newly formed Association of Special Libraries and Information Bureaux will be able to render assistance in such matters as this Undue dependence on the main classification is avoided by excellent author and subject indexes, but an illustration of the classification difficulty is provided, for example, by Prof Burstall's "Energy Diagram for Gas," which is readily traceable through the author index, but is not referred to in the subject index except under "Thermodynamics" In the body of the book the entry is made in the section on General Physics, Section ii d, Gases, whereas its place is preferably under Mechanical Engineering, Section xviii, Internal Combustion Engines It is also surprising to find Dr Aston's "Isotopes" grouped in Chemistry, Section v b, Physical Chemistry, and not referred to at all in the section on physics It is placed consistently with the scheme of classification, but this tends to be a Procrustean bed to which the books have to be fitted The grouping of the metallurgical section illustrates the main difficulty of making mutually exclusive sections when one section relates to materials (iron and steel, non-ferrous metals), while other sections relate to processes and methods (heat treatment, foundry practice, etc) Close inspection of several of the main sections shows that nothing has been omitted

It is, of course, impossible for the inexpert student to dispense with the advice of a specialist in utilising an uncritical or unannotated collection, but this volume illustrates in an admirable way what British material is available, and it will be found constantly useful in both general libraries and the ever-increasing number of specialised technical libraries all over the country In view also of the high reputation of British books abroad, it may well act as very valuable propaganda on behalf of British scientific literature

Palæolithic Art

Les Combarelles aux Eyzies (Dordogne) Par Dr L Capitan, l'Abbe H Breuil, et D Peyrony (Institut de Paleontologie humaine Peintures et gravures murales des cavernes paleolithiques) Pp iv+192+58 planches (Paris Masson et Cie, 1924) 200 francs

THIS superbly illustrated volume, recording the palæolithic art of the cave of Combarelles, is the latest of the well-known series of works which started under the auspices of the late Prince of Monaco with "Altamira" in 1906 and continued with "Font de Gaume," "Les Cavernes de la region Cantabrique," and so on These monographs have finally and for all time presented the palæolithic art of France and Spain to the student of prehistory, enabling him to do his work without having always to be visiting out-of-the-way localities and difficult caves

More even than this has been accomplished, however, for in the texts will be found careful accounts of the systematic work done in the caves themselves, where the significance of every superposition of drawings was noted, also comparisons with outside matter are included For example, in the volume under review, the chapters on the types of horse figured at Com-

barelles and their relationships with the various breeds surviving to-day will not only be read with interest by prehistorians but will also be equally appreciated by the zoologist The virgin ground broken long ago by Piette, Munro and Cossar Ewart has here yielded a rich harvest

The cave of Combarelles is one of the most important palæolithic temples in the Dordogne Although the art is nearly all engraved, there being scarcely any paintings, the beauty of the drawings and the skill employed has rarely been surpassed elsewhere The animals figured include horse (in large numbers), mammoth, reindeer, bison, ibex, bear, tiger, rhinoceros, fox, wild-ass, humans (sometimes masked), signs and so on The age of most of this art is adjudged to be Lower Magdalenian—that is, a Magdalenian before the appearance of the barbed harpoon

The present volume opens with an account of the discovery of the art and the situation of the cave, and this is followed by a description of finds from sites nearby, as well as an account of one or two objects from Combarelles itself An inventory of the art on the walls and ceiling of the cave follows, the work concludes with important comparative chapters on the occurrence of the various species of animals and the figures of humans found, and a short discussion as to the age of the ensemble

It is the plates, however, which naturally first attract the student Even those of us who knew and had studied Breuil's tracings and photographs, both in the study and on the spot, will be delighted with the results appearing here It was no mean feat for Breuil and his photographer to have worked for months on end in that most awkward of tunnels Besides the clear, distinct figures there are numbers of intricate panels representing a series of complicated palimpsests Although Dr Capitan and M Peyrony have done their part, to the Abbe Breuil remained by far the largest bulk of the work in the cave as well as the actual writing and preparing for press

A monograph of high scientific importance like "Les Combarelles" ought to make our English publishers and printers pause and think The price (200 fr) is not excessive, and it is grievous to remember that no work of this standard could ever be produced in England at even triple the price Once more is the Institut de Paleontologie humaine to be congratulated, and it is only to be hoped that further volumes will be soon appearing, giving prehistorians some more of that mass of unpublished material Breuil possesses Perhaps next time there may appear an account of that equally important and still less known Spanish rock shelter art (Spanish group III) belonging to the Late Neolithic and Copper ages

M C BURKITT

Our Bookshelf.

The Physical Chemistry of Igneous Rock Formation a General Discussion held by the Faraday Society, the Geological Society, and the Mineralogical Society, October 1924 Pp 411-501 (London The Faraday Society, 1925) 6*s* 6*d* net

THE discussion on this subject arranged by the Faraday Society excited great interest, and the collected papers contain much that is of value Whilst most of the speakers dealt with heterogeneous equilibria, and particularly with the crystallisation of minerals from magmas, one rather elaborate memoir on homogeneous equilibria was communicated by Prof Niggli, of Zurich, in which certain considerations relating to the formation and decomposition of compounds in solution are applied to rock provinces of the Pacific, Mediterranean, and Atlantic types, a diagram being used to indicate the relationships, in such a way as to point to the differentiations which may be expected to occur during cooling

Another question which recurs frequently in the discussion is that of the influence of volatile constituents on crystallisation The possibility that pressure gradients as well as temperature gradients may be important is suggested by W H Goodchild and supported by G W Tyrrell, and the presence of volatile constituents is also invoked to explain the formation of alkaline rocks Since experiments on magmas containing volatile substances can only be made in special apparatus capable of withstanding very high pressures, it has been urged that provision should be made in Great Britain for research in this field, and the paper by Dr J W Evans outlines a very extensive programme of work which should be undertaken if means permitted, including the effect of shearing forces as well as of hydrostatic pressure

Bowen's reaction principle comes in for some discussion, and the question is raised whether the methods used in metallography require much modification when they are applied to the study of such viscous and highly associated liquids as rock magmas Prof J W Gregory's detailed survey of the subject of magmatic ores leads to the remarkable conclusion that ores of magmatic origin are probably quite unimportant, all the famous deposits to which such an origin has been assigned having been shown to have been formed in other ways The little volume is most interesting and suggestive

A German-English Dictionary for Chemists By Dr Austin M Patterson First edition, with Addenda Pp xvi + 343 (New York J Wiley and Sons, Inc , London Chapman and Hall, Ltd , 1924) 12*s* 6*d* net

To compile a small dictionary from data easily available in larger works, is a comparatively simple task To compile a small dictionary of a special character, like that now under review, requires not only judgment, accuracy, and application, but also a good knowledge of the languages and the science concerned These qualifications Dr Patterson possesses to an eminent degree, and therefore it occasions no surprise to learn that his "German-English Dictionary for Chemists" has been reprinted no less than five times, and that 21,000

copies of it have been sold since the first impression was made in 1917

The book is excellent so far as it goes It is obviously not intended for the linguistic expert, the professional translator, or for other serious students of German, but for the ordinary run of chemists, who to-day know little French and less German, it is remarkably good, being exactly what they require With the aid of this small dictionary, such a chemist will be able to "make out" the meaning of almost any passage in a German chemical work, he will not, however, always be able to render it into precise and good English, because he will not always find the exact English equivalents of the German compound words he encounters As a rule, such words are easy to understand, but alas! they are also easy to mistranslate, and they occur frequently in such branches as metallurgy, spectroscopy, atomic structure, economic and engineering chemistry We hope, therefore, that when the work is revised, it will be found possible to include exact renderings of many more German compound words, so that we may be spared from errors like that made by the Frenchman who, when endeavouring to translate "hemisphere," looked up "hemi" and "sphere," and then, uniting the French equivalents in unholy wedlock, wrote down the word—*demi-monde*!

Electrical Circuits and Machinery By Prof John H Morecroft and Prof Frederick W Hehre Vol 2 Alternating Currents Pp xi+444 (New York J Wiley and Sons, Inc , London Chapman and Hall, Ltd , 1924) 20*s* net

THIS is the second of three volumes intended for the use of students in engineering colleges The first was on continuous currents (now generally called in Great Britain direct currents) The final volume will describe "experiments" We think the authors have discussed their subject in a way which will be appreciated by the average student, who has generally a very limited time at his disposal Although it is not sufficiently thorough to satisfy the consulting engineer, yet wherever possible without dragging in advanced mathematics, proofs are given The art of the electrical engineer is ever advancing Both the mercury arc and the thermionic valve rectifiers are included Sub-stations with all their apparatus in the open air (outdoor sub-stations) are described We notice that in the United States every large electrical company has an oscillograph, generally mounted on a truck, so that it can easily be transported to any point of the supply network

We are glad that the authors insist that students must know the theory of the instruments they use In too many cases students consider an ammeter, for example, as a piece of apparatus having two terminals, a pointer and a scale, and know little or nothing of what is happening inside In alternating current machinery armature reaction plays the leading part, and due stress is laid on this Particular attention is very properly devoted to the current and voltage relations of polyphase networks Too many students are content simply to memorise the necessary formulæ without taking the trouble to understand their proofs This slackness on their part will probably give them much trouble in the future, and they will never gain that confidence which is requisite for success

The Fauna of British India, including Ceylon and Burma Edited by Sir Arthur E Shipley, assisted by Dr Hugh Scott Coleoptera Clavicornia Erotylidæ, Languriidæ and Endomychidæ By G J Arrow Pp xvi + 416 (London Taylor and Francis, 1925) 30*s*

THIS volume, which is the third contributed by Mr G J Arrow to the "Fauna of British India" series, deals with three very closely related families of clavicorn Coleoptera, namely, the Erotylidæ, Languriidæ, and Endomychidæ They are all tropical groups that are but poorly represented in temperate regions The Erotylidæ recorded from the Indian fauna number 129 species, and Mr Arrow has established the new subfamily Euxestinæ for four exceptional genera which possess a rounded, solid club to the antenna The Languriidæ, with 110 Indian species, are not usually regarded as a separate family and most authorities place them among the Erotylidæ Mr Arrow, however, considers them sufficiently distinct to merit family rank, but their affinities are so intermingled with the Erotylidæ, Endomychidæ, and Cryptophagidæ that their taxonomic status is largely a matter of individual opinion Unlike the Erotylidæ and Endomychidæ, the Languriidæ feed as larvæ in stems and the imagines are very characteristically elongated The third family—the Endomychidæ—includes 120 recorded Indian species included in three subfamilies

It may be mentioned that in two features the present volume differs from its predecessors First, there is a folding map of India and Ceylon, and secondly, there is an index of plant names Both innovations add to the convenience of the users of the book The illustrations include a chromolithographic plate and 75 excellent text-figures

The whole work is well up to the standard of the previous volumes on Coleoptera, and Mr Arrow is fortunate in being able to examine the original type-specimens in a large proportion of the species, a feature which gives additional value to his identifications

A D I

Christian Missions and Oriental Civilizations a Study in Culture Contact The Reactions of Non-Christian Peoples to Protestant Missions from the Standpoint of Individual and Group Behaviour Outline, Materials, Problems, and Tentative Interpretations By Dr Maurice T Price Pp xxvi+578 (Shanghai Edward Evans and Sons, Ltd , London G E Stechert and Co , 1924) 16*s*

THIS book makes a wide appeal It is of interest to those who are actively concerned with the work of Christian missions, to anthropologists, to psychologists, and sociologists, and to those who have to deal with the practical problems of administration It approaches the work of the missionary from a novel point of view It does not deal with spiritual, theological, or metaphysical interpretations as such, but it examines the reactions of non-Christian peoples to the Christian Church's attempt to convert them—both the initial and temporary responses and those which are more permanent Missionary effort during the last one hundred years is surveyed from this point of view

For the first time missionary effort has been studied as a natural phenomenon and as a social psychological

process, without partisanship or bias The reader must not seek here for any panacea for the many ills arising out of the clash of cultures and ideals from which we are at present suffering in many parts of the world This study is purely analytical As the author points out, it is incomplete in the sense that further research is needed and consideration of the data available must be carried further in later volumes The method is capable of an application wider than the mission field, and therefore deserves the careful consideration of all who are interested in the urgent problem of the future of primitive peoples

Mechanical Design of Overhead Electrical Transmission Lines By Edgar T Painton Pp viii + 274 + 26 plates (London Chapman and Hall, Ltd, 1925) 21*s* net

THE successful transmission of thousands of electrical horse-power by overhead wires over hundreds of miles is not only feasible, but has also been proved in almost every country to be attractive from the commercial point of view Satisfactory operation has been attained by the continual attention that electrical engineers have been paying to the technique of design, and to the improvement of the quality of the materials used in construction Continuous laboratory research and long experience have enabled them to anticipate operating difficulties, and combat them by selecting suitable materials and altering the design so as to raise the factor of safety Of recent years long reports, papers, and patent specifications have been issued almost daily, and there are few who have the ability and the time to separate the grain from the chaff This volume describes the latest constructional details, and makes references to the latest specifications issued by the British Engineering Standards Association, the American National Electric Light Association, and the Verband Deutscher Elektrotechniker References are also given to many important papers published in the transactions of scientific institutions both at home and abroad Novel data in connexion with steel cored aluminium conductors are given These conductors are being extensively used, and necessitate changes in the details of transmission line design This book can be recommended to both the practical and the academic engineer The latter will see how many theorems given in examination papers have been modified to make them useful in practice

Round the World in Folk Tales a Regional Treatment Sixteen Stories from Various Lands, with a Chapter on their Meaning Compiled and edited by Rachel M Fleming (Folk Stories for the Geography, History, and Reading Lesson) Pp xi + 49 + 8 plates (London B T Batsford, Ltd, 1924) 2*s* net

THE value of folk tales as illustrative material in education is now generally recognised Miss Fleming has added to the indebtedness of teachers to her by the publication of this third collection of stories It comprises sixteen stories drawn from widely scattered areas—Australia, Melanesia, Japan, China, America, Africa, Russia, and Brittany, to name some of the sources only The bearing of the stories upon points of geography is perhaps more apparent than it was in the earlier volumes, and is further emphasised in an introductory note For example "The Legend of the Flowers" from Australia is made to illustrate the effect of climate on vegetation and animal life, and in the same way, one of the Russian stories, extremes in climatic variation Again character and quantity of food supply is a not unimportant feature which receives frequent mention, while the stories from Ireland and Brittany show the effect of the introduction of Christianity The Bushman boy's account of some of the things told him by his mother might very well be used as the basis of a contrast in educational methods among civilised and uncivilised peoples The bibliographical references are a useful guide for further study and add to the value of a book which should be widely used The illustrations are interesting and well chosen, but might with advantage have been reproduced on a larger scale

The Principles of Thermodynamics By George Birtwistle Pp ix + 163 (Cambridge At the University Press, 1925) 7*s* 6*d* net

THIS admirable little book, based on lectures given by the author in the University of Cambridge to students of varied scientific interests, contains an account of the fundamental principles of thermodynamics and their main applications to the various branches of science It opens with a brief account of the historical preliminaries leading to the two fundamental laws and the idea of entropy After an account of the chief characteristic equations for fluids, the usual mathematical relations involving the thermodynamic potentials are discussed and applied to the more elementary cases of simple and compound systems The book closes with four chapters dealing respectively with osmotic and vapour pressure, thermoelectric phenomena, specific heats, and radiation

The whole treatment of the subject is brief and almost sketchy, but it is up-to-date, well-balanced, and wholly adequate, as no essential step is missed either in the physical argument or its mathematical development The author has had the courage to cut out ruthlessly all matter which is irrelevant to his main theme, and the result is a thorough but handy account of the subject, in which the component parts are presented in their true aspect No attempt is made at a critical survey of the fundamental ideas or at a discussion of the extensive statistical side of the subject, but these would obviously have been out of place in a first book on the subject We may, perhaps, hope that the author has intentions of writing a second volume

G H L

Drogen und Drogenhandel im Altertum Von Dr Alfred Schmidt Pp viii + 136 + 8 Tafeln (Leipzig J A Barth, 1924) n p

IT has been well said that no branch of knowledge can be adequately understood without an acquaintance with its history, and this applies in full measure to a knowledge of drugs The study of the history of drugs, cosmetics, balsams, unguents, spices, etc, from the earliest written records to the present time, is so intensely interesting as to make it appear strange that so few pharmacognosists have devoted themselves to it True, Tschirch, Schelenz, and a few others have collected data, but they have, as a rule, failed to present them in an attractive form

From isolated details scattered among the works of numerous authors, Dr Schmidt has endeavoured to build up a picture of the trade that was done in these materials, the extent to which they were used, and the routes by which they reached the various markets He makes one realise that it was so considerable, and the traders so numerous, that thousands of years ago there were streets mainly occupied by their shops, and one can imagine one sees the buyers congregating there and comparing the wares offered

To accomplish this has been a task of no inconsiderable magnitude, as any teacher can testify who has attempted to compile for his students a concise but intelligible history of drugs To any one fairly conversant with German, the work is so fascinating that it can be read again and again It contains a bibliography, and in addition there are numerous references in the text it is full of most interesting details and is a valuable addition to the literature of pharmacognosy

Qualitative Analyse und ihre wissenschaftliche Begründung Von Prof Dr Wilhelm Bottger Vierte bis siebente umgearbeitete und erweiterte Auflage Pp xvi + 644 (Leipzig Wilhelm Engelmann, 1925) 19 gold marks

ON reading this valuable work one is impressed by the fact that although the experimental data underlying qualitative analysis have changed but little, their interpretation has in many respects been revolutionised the applications of the law of mass action and of the ionic theory of solution have brought order into the chaos and transformed what was once little more than a handicraft into a consistent and coherent science Nearly twelve years have passed since the third edition of Bottger's work was noticed in these columns (December 18, 1913), the new edition is a very worthy successor to the old and gives a good idea of the advances that have been made in the interval The first and more difficult part, dealing with the theoretical foundations, is particularly well done, the language is clear and simple, and the experimental illustrations are well chosen Modern views on valency and molecular structure are treated at length, and there is an interesting section on electrolytes and Werner's theory

In the experimental part are to be found many reactions of recent discovery, some of which are sufficiently specific to be used as tests without recourse to separation The treatment generally is very full, and microchemical reactions have not been neglected Books of this type are very few in these days of costly printing, and the appearance of the new and enlarged "Bottger" will be welcomed by all who are interested in this very old but still very fundamental branch of chemistry

British Birds Written and illustrated by Archibald Thorburn In 4 vols Vol 1 New edition Pp xii + 176 + 48 plates (London Longmans, Green and Co, 1925) 16*s* net

WE have received the first of the projected four volumes of a smaller and less costly edition of Mr Thorburn's "British Birds," a book first issued on a sumptuous scale in 1915 and now out of print in its original form The coloured plates, a new series, are again the principal feature, for Mr Thorburn has a well-earned reputation as an ornithological artist They are usually clear and accurate, often beautiful, and on the whole well reproduced, a few, however, are noticeably less successful than the others The text is undistinguished, consisting of very brief summaries of the usual text-book information plus a few comments, frequently in the form of quotations, upon habits or special points This is unfortunate, for it is difficult to see what function a still rather expensive book giving so little information can fulfil

One feels that the book should either have been brought within smaller compass altogether or have been expanded considerably in dealing with the more important birds Either of these courses could have been followed had Mr Thorburn been less subject to the fetish of that arbitrary category known as "the British list" Thus, no less than seven kinds of wheatear are each given a page, and all but two of them a place in the plates, whereas only one species is anything more than a very rare accidental wanderer to Britain In a popular work there would be every advantage in dismissing accidental rarities with a bare mention The confusion that there has been in ornithological nomenclature is to be regretted, but it does not help matters, now that some uniformity is being reached by general agreement, to find an author harking back for his standard to a work which was published in the previous century

A Monograph of the Mycetozoa a Descriptive Catalogue of the Species in the Herbarium of the British Museum By Arthur Lister Third edition, revised by Gulielma Lister Pp xxxii + 296 + 223 plates (London British Museum (Natural History), 1925) 31*s* 6*d*

A THIRD edition of the monograph of the Mycetozoa by Arthur Lister has been prepared by Miss G Lister and issued by the Trustees of the British Museum Few groups of organisms have been so well catered for in the way of an accurate and well-illustrated systematic monograph and the appearance of a third edition tells at once of the attractiveness of the organisms themselves and of the interest stimulated in any group when a sound treatise is available

Biologists may have imagined that the Mycetozoa were fairly thoroughly known when the second edition, published in 1911 (which also introduced a revised nomenclature in accordance with the International Rules), included all additions to date It is surprising, therefore, to note that no less than three additional genera, 46 species, and some 50 additional varieties, are incorporated in the present volume The results of recent biological research are also included

The work of revision having been in the experienced and accomplished hands of Miss Lister gives assurance that the new edition is of the same standard of excellence as its predecessor

Faune de France 8 *Diptères, Tipulidæ* Par C Pierre (Federation Française des Societes de Sciences Naturelles Office Central de Faunistique) Pp 159 (Paris Paul Lechevalier, 1924) 25 francs

THE present instalment of this useful series deals with the crane flies Since the work is primarily intended for the identification of the adult insects, there is only a short account of their biology and metamorphoses

Osten-Sacken's division of the family into Longipalpi and Brevipalpi is followed and four subfamilies are recognised, namely, Tipulinæ, Cylindrotominæ, Lomnobiinæ and Trichocerinæ. For the venation Tillyard's modification of the Comstock-Needham system is adopted.

The method of treatment of the family is by means of keys, which take the reader step by step from the subfamilies to the tribes and thence to genera and species. In the case of the larger genera the species are sorted out into groups in order to facilitate identification. The specific characters are further enumerated in a little more detail in the lists which follow the keys, and notes are given as to distribution and so on. The numerous text-figures are almost entirely devoted to the genitalia and venation, excepting two pages of illustrations which depict the larval and pupal characters of the Limnobiinæ. The work will prove useful to English dipterists, as very little has been published on the British forms for nearly forty years, excepting Edward's revisional notes (1921). A. D. I.

The Botany of Crop Plants: a Text and Reference Book. By Prof. Wilfred W. Robbins. Second edition. Pp. xxi+674. (Philadelphia: P. Blakiston's Son and Co., 1924.) 3.50 dollars.

THE usefulness of this volume is indicated by the fact that a second edition has been called for in the comparatively short period of seven years. Opening with an outline morphological sketch, the author proceeds to give an account of the various crops grown in the United States, gathering together information that is otherwise very scattered. The crops are dealt with under the headings of their respective natural orders, the more important, chiefly cereals, being described in some detail. Bibliographies are appended to each crop or group of crops, but do not pretend to be complete. The classification of the varieties or types of crop is simplified by the free use of keys, many of which are original. A feature of the book is the "direct" method of labelling the very clear illustrations, thus rendering them more easy of reference for the student. A glossary of botanical terms and a good index round off a book that should prove of considerable value to agriculturists as well as to botanists.

Pecan-Growing. By H. P. Stuckey and Prof. Edwin Jackson Kyle. (The Rural Science Series.) Pp. xiii+233+12 plates. (New York: The Macmillan Co., 1925.) 12*s.* 6*d.* net.

THE growing importance of the pecan-nut in American commerce has justified the production of this book dealing with the crop in all its aspects. The pecan, *Hicoria pecan*, is closely allied to the walnut, and now ranks second to the latter in the nut production of the United States. Propagation is not easy, and special attention is devoted to descriptions of the various methods of budding or grafting that it is necessary to employ. An interesting feature is the account of the National Pecan Growers' Exchange, an organisation for marketing the nuts by means of a grower's co-operative non-profit association without capital stock. Such a body tends to raise the standard of the crop owing to its system of careful grading and differential prices. Lax supervision in the earlier years of cultivation favoured the introduction and spread of many insect and fungus pests, which now need to be combated to prevent serious reduction of the nut crops. The volume concludes with a discussion of the food values and descriptive accounts of the many varieties of the pecan.

Distillation Principles. By C. Elliott. (Chemical Engineering Library: Second Series.) Pp. 166. (London: Ernest Benn, Ltd., 1925.) 6*s.* net.

MR. ELLIOTT's book contains, on the whole, a clear and readable account of a subject which most students find difficult. In a few places the text is not so perspicuous as it might have been, but the general treatment is sound. Particular stress is laid on the work of Rosanoff, which the author says he has found helpful, and the methods adopted certainly appear practical and useful. A fair amount of mathematics is essential, but the full discussion of numerical results gives the treatment a sense of reality which is most gratifying. It may be noted (p. 24) that the molecular weight of hydrogen is not 2, and that 2 grams of hydrogen do not occupy 22.412 litres. Biot's vapour pressure formula (p. 21) is the only one given, whilst Kirchhoff's is perhaps more useful; Avogadro's law does not state (p. 34) that "the volumes of gases are proportional to their molecular weights." Useful tables are given in an appendix. The book can be recommended as a concise and accurate account of a difficult subject.

An Introduction to the Literature of Chemistry: for Senior Students and Research Chemists. By Dr. F. A. Mason. Pp. 41. (Oxford: Clarendon Press; London: Oxford University Press, 1925.) 2*s.* net.

THE idea of assisting the research student by explaining how to make use of the literature is a good one, and a satisfactory book on these lines would be most useful. Unfortunately, Dr. Mason has not made the most of his opportunity. He has omitted to mention many of the best works of reference, and his critical remarks are not always such as would meet with general agreement. The section on physical chemistry is particularly unsatisfactory, and no guidance as to consulting the literature is given in this part. In future editions, the author would do well to seek advice from specialists, and to find out what books are, in fact, most consulted in the large libraries. His lists read as though based on a rather arbitrarily selected private library.

Acid-Resisting Metals. By Sydney J. Tungay. (Chemical Engineering Library: Second Series.) Pp. 136. (London: Ernest Benn, Ltd., 1925.) 6*s.* net.

MR. TUNGAY deals with various types of acid-resisting metals, such as silicon-irons, lead and regulus metal, aluminium, stainless steels, monel metal, cast iron and steels, nickel and chromium alloys, copper and copper alloys, in an interesting way, and has succeeded in giving a large amount of useful information in small compass. The use of acid-resisting metals has changed many aspects of chemical engineering practice and holds out prospects of further applications. The information in the book, when it is not directly based on the author's own experience, is carefully compiled from good authorities, and the result is that one can rely on the correctness of the statements. The book can be warmly recommended.

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Future of the British Patent Office

THE burden of Mr. Wyndham Hulme's letter (NATURE of September 5) is that, as regards basic principles in the granting of patents for inventions, there should be a reversion to the principles which obtained during Elizabethan and early Jacobean times, and that in every particular Patent law should be made subservient to the successful establishment of industries in Great Britain. Thus although a "manufacture" might have already been known, yet if it had not been reduced to practice, a valid patent should be obtainable by anyone who was the first to put the "manufacture" into practice. Further, Mr. Hulme contends that, if novelty is to be the test for validity of a patent it is practically impossible for a thorough search to be made by a body of officials, and that since an administrative search for novelty has long been an economic absurdity, the growth of British industry should be stimulated by a relief of the patentee from an unduly high legal standard of novelty.

There is of course always much which deserves close attention in any of Mr. Hulme's observations upon Patent law and its administration and I regret therefore that I am not altogether in agreement with the views he is now expressing.

Dealing with the topics touched upon by Mr. Hulme, I think the nature of the consideration for a patent is quite clear, namely, the publication through the Patent Office of an invention which was new when the application for the Patent was made. I agree that the meaning of the term "new invention" has changed considerably during the last three hundred years. There is not much doubt that during early Jacobean times the test for novelty lay in the direction of discovering whether or no the patented invention had been "manufactured" in England. This arose from the fact that knowledge of an invention was much more likely to have been secured through it having been manufactured than through its having been described orally or in writing. But I doubt not that, even in these early times, "novelty" would have been destroyed if on a test case having been brought before the Courts, it had been proved that the industry or invention had been known in some way or other. Unfortunately, so few cases have been reported where patents were fought in early times. The decisions of the Privy Council are all right so far as they go, but the Council often acted despotically and was not very anxious to abide by the letter of the law where the supposed interests of the nation or the interests of favoured individuals were primarily concerned. A discussion, however, of the relation of the Privy Council to the Courts of Law is one that cannot be entered upon here beyond saying that there is ground for supposing that the Privy Council often usurped jurisdiction where patents for invention were in question.

When writing became a general method of transmitting information, it was not surprising that, early in the eighteenth century, the means for imparting information concerning a new invention was concentrated upon the "Specification" and that, in consequence, the prior publication, among other things, of a writing which described an invention, should be held to be destructive of validity of a patent granted for that invention.

I think that there is a good deal to be said for the view that the original object of granting patents was the establishment of industries in England, and that if a patent was found not to have resulted in the establishment in this country as opposed to establishment in other countries, the consideration for the patent had failed. It is clear that the Courts of Law receded further and further from this view of the early law and that statute law attempted and still attempts to reinstate the original condition for the granting of patents. Whether the statutes have been successful or no is a matter upon which much diversity of opinion is present, and together with the question whether such restriction is advisable are subjects too big to deal with here.

As regards Mr. Hulme's two basic principles (*a*) and (*b*), I do not think that they are necessarily antagonistic, for in numberless instances the institution of a new industry has followed upon the disclosure of an invention. Indeed, I think it would be so difficult as to be impossible to grant patents upon the strength of the setting up of a new industry as opposed to the disclosure of an invention in writing deposited in a public office.

With respect to the granting of patents with relatively narrow claims that necessarily and rightly follows when a search has shown that wider claims would interfere materially with the existing rights of the public. It is only just that when an inventor has added but little to the stock of public information, his monopoly rights should be proportionately reduced, and that when by an official search an inventor has been shown to be worthy of little protection, his patent rights should be virtually negligible. There is no reason, however, that when an individual has truly discovered an invention of immense and wide importance his patent, as is the case at the present day, should not be proportionately broad and his security of the highest. This means that I do not agree that when security is at its highest, restraining power is necessarily at its lowest.

The anonymous letter which Mr. Hulme quotes scarcely seems relevant. The practice of the United States Patent Office as regards claims and the law of the United States in respect of the interpretation of specifications and claims differ so much from ours that, granting what is said to be correct, the letter is but a complaint about patents granted in the United States of America.

With respect to search for novelty to which Mr. Hulme also refers the complaint really comes down to saying that since perfection cannot be obtained in practice, it were better to have no search at all. I cannot agree to this; and I should have thought that the more thorough the search the more secure is the patent.

As regards relief of the patentee from the unduly high legal standard of novelty as mentioned by Mr. Hulme, it must be remembered that members of the public have the right to employ any extant information which has not been the subject of a patent, the term "extant information" including the associated knowledge which is the property of the expert or operative. It can scarcely be right that a patent should be granted to one who for his own purposes selects extant information, and that the public should be restrained from utilising what, before the patent was granted, they had a right to employ.

Concerning overlapping claims, I understand that it is the practice of the Patent Office to prevent this so far as it is possible. All of us are desirous of simpli-

ying procedure, but in our zeal for simplification we must be careful not to admit abuses

I agree entirely with Mr Hulme's conclusion it is only when we face at close quarters the means to be adopted that we may find ourselves at variance

WILLIAM MARTIN

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The Theory of Hearing

A SERIES of communications by Scripture, Wilkinson, and Hartridge concerning the mechanism of hearing has recently appeared in NATURE In Prof Scripture's most recent letter (February 14, p 228) the work of Fletcher (*Phys Rev*, March 1924) and that of Wegel and Lane (*Phys Rev* February 1924) are stated to be irreconcilable with the so-called " resonance theory " of hearing and as being in accord with a " pattern " or " deformation " theory which he advocates

The definition of resonance in the popular sense involves the psychological factor of perceptibility of continued free vibrations after the driving force has ceased to act If " resonance " is understood in this popular sense, the " resonance theory " of the cochlea is improperly named Helmholtz took great pains to show that in order to explain " shakes," the vibrating areas on the basilar membrane cannot be " resonant " The damping of these selective areas obtained from data given in the Wegel and Lane paper indicates for the mid range of audible frequencies that the amplitude of free vibrations of each area diminishes to a value $1/e$ (roughly 1/3) of its initial value in from 1 to 10 vibrations or in from 0 01 to 0 001 seconds The vibrations are apparently not aperiodic but are highly damped We may, therefore conclude that the theory in question amply accounts for the suppression of free vibrations, *per se*, beyond the point of perceptibility and, consequently, does not lead to the prediction of what Prof Scripture calls " jangle " or " noise and jumble of sounds

A description of the pattern of vibration of the basilar membrane as predicted by the " resonance theory " will perhaps make the matter clear Fig 1

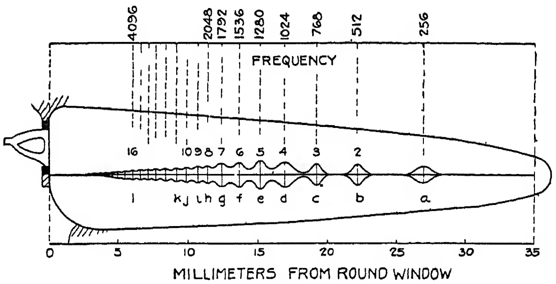


FIG 1

shows, in longitudinal section, the pattern of deformation of the basilar membrane in response to a sustained musical tone of pitch 256 (middle C) The amplitudes are of course enormously magnified when compared with the length of the membrane This figure is made from quantitative data obtained from the paper (Wegel and Lane) referred to above The pattern consists of a series of vibrating areas on the basilar membrane roughly elliptical in contour These areas are larger and farther apart at the apical end of the membrane and closer together and tending to overlap near the basal end The area, *a*, vibrates at 256 cycles or vibrations per second and corresponds to the fundamental or cord tone described in Prof Scripture's book " Elements of Experimental Phonetics " Area *b* vibrates at 512 cycles and corresponds to the second harmonic or first over-tone Each harmonic is represented by a characteristic area At points where two successive areas overlap, the membrane vibrates at the two frequencies simultaneously, causing a more or less irregular stimulation of the nerve terminals If the relative amount of higher harmonics which produces the overlapping areas, is so great that the resultant sensation is largely due to them, the sensation is that of poor musical quality

If the pitch of the tone is changed, the pattern moves bodily along the membrane without great change in form When however the pitch is exceedingly low, the areas *a b c*, tend to be closer together and wider When very high the maxima of the overlapping areas are crowded closer together The loudness of the note depends on the absolute amplitudes of vibration of these areas and the quality depends chiefly on the ratios between the amplitudes. The sounds from a bell or cymbals, or from a vibrating plate or bar produce patterns on the basilar membrane consisting of vibrating areas differently spaced from those shown in the figure. A noise disturbs the whole membrane instead of exciting separate areas in the simple manner indicated in the figure Owing to the high damping, the vibrations of the membrane remain sensible only while the sound continues

When a musical chord is sounded the pattern is more complex than in Fig 1 The pattern for a tone of pitch 512 is like that in the figure for 256 except that it is displaced to the left a distance *a b* If both tones are sounded together the resultant pattern consists of a superposition of the two patterns The areas set in vibration by the higher tone coincide exactly with the even numbered areas excited by the lower one The resulting amplitude at any one of the even numbered areas may be either smaller or greater than the amplitude there produced by either tone alone, depending on the phase differences of the tones If the octave is not exact, beats result at the even numbered areas If these beats are very rapid a discord results A chord consisting of several notes, results in a pattern on the basilar membrane consisting of the superposition of a number of patterns, properly spaced, each like that in the figure, one for each note in the chord

The portamento or glissando in order to be well executed, must take an appreciable time, say $\frac{1}{4}$ or $\frac{1}{2}$ second A portamento through the octave 256 to 512 is represented by a shift of the pattern in the figure through a distance equal to *a b*, the pattern at any time being identical in position and form, so far as it would be possible to distinguish with a pattern produced by a sustained tone of the identical pitch falling on the ear at that instant The pattern resulting from the sound of Prof Scripture's accelerated toothed wheel behaves similarly A voiced sound in speech is represented by an appearance of such a pattern on the basilar membrane a movement to and fro to correspond to the variation in pitch of the chord tone, a correlated variation in actual and relative amplitudes of vibration of the areas to correspond to changes in loudness and quality respectively, and a disappearance, all in sensibly exact synchronism with the spoken sound

The sense of pitch of a tone is determined from the position of the root area, *a* (Fig 1), of the series of areas on the membrane When, for some reason, the lower harmonics are very faint or absent from the tone, the root and first few areas are missing from the pattern, but the root position, and therefore the pitch of the tone, may be inferred by a psycho

logical process of association The habit of association of the root area with the pattern position, therefore, accounts for Fletcher's experiments independently of the existence of non-linearity in the ear When more and more low harmonics are eliminated, *e g* with filters, as in Fletcher s experiments, the sense of a definite pitch fades and merges into a high pitched noise having poor musical value

At the higher levels of loudness, however, non-linearity (presumably greatest at the malleo incal joint) undoubtedly comes into play This compensates to a certain extent for cutting out the missing lower frequencies by resupplying them in more or less reduced amounts as difference tones, to the complex vibrations entering the cochlea The result of this process is to give a more definite sense of pitch than association alone could do Just what relative parts are played in Fletcher's experiments by association and by non-linearity is not certain, but experience certainly indicates that for loud sounds the latter plays a considerable part

It will now be seen that Prof Scripture's remarks concerning his own hypothesis apply equally well to the "resonance theory" Quoting from his article above referred to "According to this [Scripture's] theory, the basilar membrane alters the linear movement of the stapes into a change of form in three dimensions Every external vibration produces a pattern deformation of the membrane This pattern is communicated to the brain A single vibration of a clarinet tone produces a definite pattern in three directions on the basilar membrane The mental quality of the clarinet tone represents this pattern When this vibration is repeated regularly, the clarinet quality appears to be based on a tone of definite pitch"

An extended Helmholtz or resonance theory is the only present dynamical theory which conforms to the well-known laws of vibrational mechanics The cochlear model of Wilkinson (*Journal of Laryngology and Otology*, September 1922) has demonstrated concretely that this type of mechanism is selective after the manner supposed by the resonance theory

Progress in this field of investigation would be more rapid if those who are at work in it made greater efforts to understand each other's methods and terminology R L WEGEL

Bell Telephone Laboratories, Inc

The Distribution of the Two Electrical Zones in the Atmosphere

I HAVE examined the fair weather potential gradient on several mountains in the Bernese Oberland, and find that the positive zone, in summer at midday, extends from sea-level to above the Jungfrau (13 671 ft) When observations at greater heights are available it may be found that it reaches up to between that and 20 000 ft above sea-level in Central Europe

As the positive potential was lowest before sunrise, and reached a maximum in the afternoon which was maintained until near sunset, it is possible that the outer negative zone approaches near to the earth's surface during the night, and recedes during the hours of daylight

That the properties of this zone on the mountains are due to positive gas ions is proved by the study of mountain mists In the simplest cases the formation of mountain mists can indeed be followed by the eye, but at times those drifting from and covering the Bernese Oberland extend for several miles, and their origin and nature are then uncertain

In most cases I find, on electrical examination, that the "clouds" surrounding the mountain tops in summer are in reality ground mists They proved to be positively charged on the Eiger, Jungfrau, Fischerhorn, Wetterhorn, and Faulhorn, and in each case they possessed the property of increasing the fine weather positive potential at the position temporarily, due to causes I have already described (NATURE, May 30, 1925, p 836)

Electrical examination seems to be the only certain method of distinguishing between mountain mists and clouds, for on one occasion during broken weather a true upper cloud, negatively charged and optically indistinguishable from mist, descended for a time and surrounded the summit of the Faulhorn Significantly, the temperature, which had stood at 10° C for some hours, fell to 4° C very rapidly Hail, rain, and snow on the Faulhorn (8800 ft) were always negative after the passage of the positive sheath

When the magnificent panorama, seen in cloudless conditions from the summit of the Faulhorn, was examined about sunset I noted that there are *two optical zones* in the atmosphere, which are not noticeable at lower altitudes or when the sun is higher in the sky The upper was clear and brilliant, and there was a lower, grey, hazy zone which rose from the ground-level to several thousand feet above Pilatus (7000 ft) and Nollen (8800 ft) The zones were most easily traced against the darker northern background, being lost among the dazzling snow-capped peaks of the Oberland

During a cloudless sunrise the same zones were apparent, but the junction was considerably nearer to the summit of Pilatus than at sunset It was when the lower edge of the sun's disc entered the lower zone that its red coloration became visible, and the Alpine glow commenced As the lower zone extended higher above the horizon in the evening than at sunrise, this seems to account for the superiority of the sunset coloration, for at sunrise the solar disc quickly emerges above the lower zone

It seems to me probable that the two optical and electrical zones are identical, and that the red colorations of sunset and sunrise are therefore largely due to absorption of solar radiation by positive gas ions (together with associated water molecules ?) If further investigation confirms this view, an optical method of determining the height of the positive layer above the ground is provided, for the time of entry of the sun s disc into the lower zone can be fairly sharply determined on still cloudless evenings The height of the lower layer is variable in strong winds and unsettled weather Strong ionisation and absorption of solar radiation may occur in the outer layer of the positive zone

In the light of a two-layer atmosphere the accepted explanation of the mirage may require revision

As the height of the positive zone appears to be mainly a function of local absorption of solar radiation, recombination during darkness, resulting in shrinkage, we may expect the outer negative zone to approach much closer to the earth's surface in the Arctic and Antarctic circles during polar winters, and such thinning out of the positive zone may be a factor in the phenomena of the Aurora A significant fact in this connexion is the absence of thunder and lightning near the Poles to which Dr Simpson has directed attention (NATURE, April 14, 1923, Supplement, p x) I recently explained (*ibid*) that disruptive discharge is due to the intense electrification resulting from the formation of the positive sheath about the negative clouds when the latter descend quickly into the lower positive zone, especially about the vanguard Where the clouds do not descend into the positive layer there would be no sheath and no lightning

Observations of the height of the positive zone during daylight and darkness are urgently wanted.

Ticho (15,885 ft) at the head of the Peruvian Central Railway, should provide an accessible site for the tropics Alpine meteorologists have their choice of several positions The mountains of northern Scandinavia, and Spitsbergen, would provide valuable data nearer the Pole Once charted, mathematicians can calculate from the relative motion of the upper air and the earth how much of the earth's magnetism is explicable, and wireless experts can appraise the influence of the zones in long-range transmission

In conclusion—a word of warning I have previously shown that the enormous quantities of positive gas ions poured out from steam locomotives makes observation in England uncertain, and near towns entirely misleading In Swiss valleys this factor is now negligible but another disturbance exists there At Grindelwald the spray from the turbulent Lutschine and numerous waterfalls and cascades, carries its negative charge to considerable distances—200 yards on either side of the stream near the gorge Water (like all conductors) in the open air has an induced negative charge on it in fair weather, and on severance the spray carries the negative charge with it

William C Reynolds

" Wharfedale ' Upminster
Essex August 20

The Motion of Eruptive Solar Prominences

In the issue of Nature for July 4 p 30 Mr Evershed has reviewed a paper by Edison Pettit on the " Forms and Motions of the Solar Prominences " Dealing with the motion of eruptive prominences, Evershed thus summarises the opinion of Pettit " The memoir concludes with a theoretical discussion of the nature of the repulsive force acting on prominences Radiation pressure is rejected as inadequate and the periodic ejection of showers of electrons from a disturbed area in the photosphere is suggested tentatively "

I have recently contributed a paper to the *Astrophysical Journal* in which the motion of eruptive prominences is discussed at some length Working on the lines initiated by Saha and Milne, I have shown that selective radiation pressure provides the motive force for the motion of prominences The selective radiation pressure is due to the bright patches or filaments which develop on the solar photosphere and are always found associated with eruptive prominences St John has recently shown that the spectra of the faculæ and filaments show the lines of Ti much enhanced over those obtained from the undisturbed photosphere, and hence the conclusion is that they are regions of higher temperature

Milne has shown that the high level Ca^+ atoms emitting H and K lines are supported against gravity by the pressure of the photospheric radiation When regions of the photosphere get locally heated the equilibrium in the region above is disturbed, and Ca^+ emitting H and K and hydrogen atoms emitting the Balmer lines acquire an accelerated velocity The motive power is thus obtained from the excess of radiation pressure due to the development of filaments at the base over the solar gravity

Pettit, however, has shown that the motion is not accelerated but uniform for some time and then actuated by impulses A steady velocity can only be reached if the particles move in a resisting medium Probably the frictional force is supplied by the Einstein coefficient of resistance

$$\mathrm{R} = \frac{8\pi h^2\nu^4}{3c^5} \quad \frac{e^{h\nu/k\mathrm{T}}}{e^{h\nu/k\mathrm{T}} - 1} \quad \frac{\mathrm{B}_{1\to 2}}{1 + e^{-h\nu/k\mathrm{T}}}$$

where $\mathrm{B}_{1\to 2}$ is Einstein's probability factor of absorption Thus Pettit's results are not inconsistent with the theory But in some cases, as Evershed has remarked the motions of the eruptive prominences decidedly show continuous acceleration These cases may be explained thus The Einstein coefficient of resistance R works out to be a small number The radiation pressure on the other hand may increase to a sufficiently high value if the fluctuation of temperature or the size of the bright patch at the base is large enough In this case the prominence will reach a great height before anything of the nature of a constant terminal velocity is acquired In the meantime the velocity will continually increase, but the absolute magnitude of the acceleration will continually decrease The impulsive increments in velocities are due to the sudden changes of temperature at the base

All electrical theories must be discarded for large motions are observed in the case of lines of hydrogen which are due to neutral atoms Electrical forces cannot act on neutral atoms

For detailed argument reference is to be made to the original paper

Ramani Kanto Sur

Physics Department,
Allahabad University,
July 29

I agree in a general way with the view that the motion of the eruptive prominences, and of the absorbing gases in novæ, may be best explained by selective radiation pressure

The structure of the chromosphere itself suggests an outward movement along innumerable streams or jets which are perhaps based on the brighter spots in the rice-grain structure of the photosphere

There is a difficulty when we study the distribution of the larger eruptive prominences with respect to the faculæ, or brighter regions of the sun s disc While it may be difficult to locate precisely the origin of eruptions when observed at the limb, they often seem to occur in high latitudes outside the spot-zones, and they appear usually to be connected with the larger patches of absorbing gas which are photographed on the disc of the sun in the calcium lines or in Hα These patches tend to lie outside the faculous regions, either in high latitudes or in longitudes intermediate between the great regions of sunspot disturbance There is thus no evidence that the photosphere underlying these prominences is brighter than normal

On the other hand eruptions of a somewhat different character are observed in the immediate neighbourhood of sunspots and these may be connected with the faculæ In rare instances they are accompanied by a phenomenon suggestive of the outburst of a nova namely, a great but temporary increase of brilliancy in the photosphere, such as was observed by Carrington and Hodgson in 1859 Such disturbances are usually associated with line-shifts indicating motions of the order of hundreds of kilometres per second

J Evershed

Spermatogenesis of Spiders and the Chromosome Hypothesis of Heredity

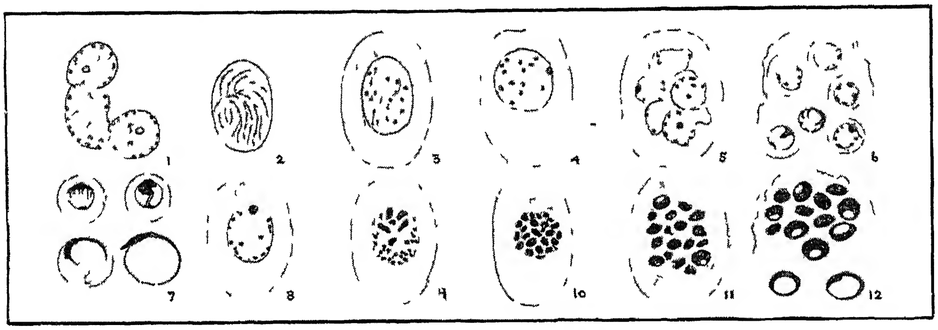
From certain observations which I have recently made, it would appear that the spermatogenesis of some spiders exhibits interesting peculiarities which do not readily accord with the rigid scheme required by the chromosome hypothesis of heredity

I have more especially studied the spider *Palystes natalius* Karsch, but certain other spiders have

similar peculiarities in their spermatogenesis The spermatogonial nuclei divide by amitosis only, and no trace of mitosis was seen in the numerous sections examined (Fig 1) The spermatocyte nuclei form a more or less typical spireme in which many "chromomeres" develop (Fig 2) The spireme breaks down and the "chromomeres" are left free they grow into rounded chromatin granules of considerable size (Fig 3) From these spermatocytes, spermatozoa arise in two ways, as follows

(1) The spermatocyte nucleus buds or fragments in a somewhat irregular manner and gives rise to a small cluster of nuclei, each of which becomes surrounded by differentiated cytoplasm (Figs 4-7) These small cells are the spermatids, and with the most careful observation it is not possible to affirm that only four spermatids are formed from one spermatocyte, in fact the number seems to be irregular and usually more than four The nucleus of the spermatid becomes hollow and the chromatin concentrates at one pole and gives rise to the spermatozoon, which afterwards becomes spread over the swollen cytoplasmic vesicle like a fish-embryo stretched over its yolk-sac

(2) The numerous chromatin granules of the spermatocyte condense and form a considerable number of large masses resembling definitive chromosomes, but when first formed there seems to be no constancy in size, and also there is no definitely fixed number Afterwards these chromatin masses become more or less rounded and uniform in size and the cytoplasm of the spermatocyte disappears almost entirely (Figs 8-12) There is thus formed a compact cluster of oval, or rounded, free chromatin-bodies Each of these bodies becomes hollow and produces one spermatozoon which is differentiated peripherally



When mature the spermatozoa originating in this way are somewhat smaller than those formed according to the first method described above These uncoiled or unexpanded spermatozoa may occur in abundance mixed with expanded forms in the semen contained in the spermathecæ of the female spider From this account it is clear that the "spermatocyte" produces far more than four spermatozoa

It is of special interest to note that in the second method of spermatogenesis traces of achromatic spindles may occur sporadically in association with the clusters of chromosome-like bodies and these bodies may even become temporarily arranged in an erratic manner in the equatorial plane It is as though the ancestral condition is not completely forgotten

These peculiarities in the spermatogenesis of Palystes are doubtless associated with the fact that in the development of the tissues of the embryo a very considerable amount of amitosis normally occurs and with the present evidence it seems totally impossible to assume that the offspring of cells which have divided by amitosis are incapable of dividing by typical karyokinesis

It would be obviously absurd to suppose that the mechanism of heredity differs fundamentally in certain spiders from that in other organisms, and if these observations are duly confirmed, and I can see no escape from them, the upholders of the chromosome hypothesis, which naturally hangs on its weakest link will have to be content with a much less rigid chromosome behaviour than is usually assumed

A detailed account of the observations is being prepared for publication ERNEST WARREN

Natal Museum

The Transmutation of Uranium into Uranium X

As described in the *Journal for Applied Chemistry* (Berlin Leipzig, No 32 1924) the present writer succeeded in 1922 in observing the transmutation of mercury into other elements, when submitted to the effect of a strong electric discharge This discovery was described in a manuscript deposited under G 56485 IV/12 h on May 3, 1922, in the German Government Patent Office, where it may be seen by anybody It is therefore incorrect to state that Miethe first observed the transmutation of mercury

This must be expressly stated here in order to assert the priority of the present writer and to justify the further experiments carried out during the period 1922–1925 in a domain which was offering no promise at all at that time After the discovery of the transmutation of mercury, it was natural that other elements especially uranium and thorium which are subject to spontaneous disintegration should likewise be examined for the possibility of artificial transmutation

For this purpose the behaviour of uranium and thorium and their salts in the electric arc and in the glow discharge in evacuated tubes has been examined In no case could there be observed an alteration in the radioactivity or in the chemical activity A perceptible transmutation effect was however, unexpectedly found when strong rushes of momentary high-tension currents were sent through a narrow fused quartz tube provided with tungsten electrodes and containing mercury and uranium oxide The tube was fixed vertically in a stand, so that the mercury filled the lower part of the tube and one tungsten electrode was completely covered by it On the surface of the mercury was a relatively thin coating of uranium oxide which had been carefully freed from radioactive by-products especially from uranium X, before it was introduced into the quartz tube The sparking distance between the tungsten electrode and the mercury-uranium oxide electrode was about 15 cm The intensity of the electric discharge varied between 0 3 and 0 4 amp

Under the influence of repeated electric discharges during about thirty hours, relatively strong and

increasing radioactivity measured according to the β- and γ-rays method showed itself The tube hermetically sealed was also laid on a photographic plate enclosed in an aluminium box After six hours a very perceptible blackening appeared on the part of the photographic plate corresponding to the quartz tube The contents of the tube were dissolved in nitric acid From the solution the artificially produced radioactive material was separated by all the known methods by which uranium X can be separated from uranium Observation of the decrease of the radioactivity showed the half-period time to be that of uranium X The identity of the radioactive material generated with uranium X was thereby proved The β and γ ray activity of the uranium oxide freed from the mercury varied between 1 4 and 20 times the radioactivity of an equally large amount of uranium oxide in equilibrium with its decay products and increased proportionally to the energy applied and to the time

One obtains even a greater production of uranium X if one makes in analogy to the experiments of Nagaoka, as described in NATURE of July 18 the electric discharges pass within a thick sided quartz or porcelain vessel between a tungsten point and mercury covered with a thin coating of vaseline and uranium oxide This coating possesses such a high electric resistance that even when applying the highest tensions which can be obtained, one is obliged to diminish greatly the sparking distance in order to obtain a discharge This proceeding offers the advantage that the energy is concentrated into a very small space Consequently one can show after half an hour s work, the production of relatively large quantities of uranium X It should be stated, of course, that before the tests all parts of the apparatus were examined as to radioactivity and found not to be radioactive

The production of uranium X considerably in excess of that produced by spontaneous decay is to be explained only by the fact that, under the influence of the electric force an acceleration of the radioactive transmutation of uranium takes place

A GASCHLER

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Some Simple Characteristic Relationships among the Ferromagnetics

THERE are some simple relations existing among the ferromagnetic bodies which no doubt have a fundamental significance If we calculate the ratio of the critical temperature on the absolute scale (θ) to the maximum intensity of magnetisation (I_0) for each of the ferromagnetics, we obtain the following values for θ/I_0

Iron	$1058/1817 = 0\ 58 = 2 \times \frac{8}{27}$
Cobalt	$1348/1422 = 0\ 95 = 3 \times \frac{8}{27}$
Nickel	$661/552 = 1\ 19 = 4 \times \frac{8}{27}$
Magnetite	$808/431 = 1\ 83 = 6 \times \frac{8}{27}$

Thus θ/I_0 is proportional to the simple numbers 2, 3, 4, and 6 The fraction $\frac{8}{27}$ is the numerical constant in the equation to the critical temperature, namely,

$$\frac{\theta}{I_0} = \frac{8}{27}\frac{a'}{R'},$$

where a' is the constant of the intrinsic field and R' is the reciprocal of Curie's constant

We may ask if a new ferromagnetic material were to be discovered would it fit into this scheme, in short, are these simple whole numbers necessary to ferromagnetism?

In Heusler s alloy we have such a new ferromagnetic material and an examination of its properties provides one answer to this question Recently Prof Thompson kindly supplied me with a sample of this alloy, prepared in the metallurgical laboratory of the University of Manchester and experiments with it show that its critical temperature is 355° C or 628° on the absolute scale, and the maximum intensity of magnetisation is approximately 420 Hence the ratio of θ/I_0 is $628/420 = 1\ 50$ and this is very nearly $5 \times 8/27$ Thus Heusler s alloy conforms to the whole number rule and moreover it fills the vacant space between nickel and magnetite so that the consecutive numbers from 2 to 6 are now complete These numbers are exactly whole numbers within the accuracy with which θ and I_0 are known

When it is remembered that three of these ferromagnetics are metallic elements, one is a definite chemical compound and another is an alloy of three non-magnetic metals, these results are all the more remarkable

There are one or two other simple relations closely connected with the foregoing for example, the ratio of the maximum intensity of iron to that of nickel is 3 3, and the ratio of the intensity of cobalt to that of magnetite is likewise 3 3 Similarly the ratio of the critical temperatures of iron and nickel is 1 60 and of cobalt and magnetite 1 67, so that these ferromagnetics fall into two closely related groups

J R ASHWORTH

55 King Street, South
Rochdale August 20

Planetary Densities and Gravitational Pressure

WITH reference to Mr Mallock's letter in NATURE of July 4, I beg to point out that the gravitational forces in his supposed envelopes will increase their density to a value comparable with that of a solid unless the planets are very hot indeed The stability of the belts and spots on Jupiter and Saturn is a serious objection to the existence of such thick envelopes

As to the compressibility of solids, the electrostatic theory of molecular structure is inconsistent with great increases of solid density Surely Mr Mallock's chalk experiment indicates that in the lower chalk the conditions are nearly crystalline and not that simple compression can produce important changes in density

HERBERT CHATLEY

Whangpoo Conservancy Board,
Shanghai, August 4

The Word "Australopithecus" and Others

IN answer to Dr Lucas s letter (NATURE, Aug 29, p 315) it may be said that although scientific names need not be literature, and therefore need not follow any philological rules, yet where they pretend to be derived from Greek, or Latin, or any other particular language, good taste demands that they should conform to the structural system of that language

We "scientists" are contemptuous when the unscientific misuse our terms if we wish to avoid the contempt of literary folk, we should be careful how we use theirs

F J ALLEN

8 Halifax Road
Cambridge,
August 30

Organic Evolution [1]

By C Tate Regan, F R S

FOR any profitable discussion of the origin of species it is essential to know what we mean when we use the word "species" In Nature we find that a number of similar individuals, with similar habits, live in a certain area, such an aggregation of individuals may be termed a community It is unfortunate that this word has sometimes been used for dissimilar and unrelated organisms that occur together—for example, the animals found on a muddy bottom in the North Sea, or the plants of a range of chalk hills—but I am satisfied that the word "association" is more appropriate to these, and that "community" is the right name for a number of similar individuals that live together and breed together All this is preliminary to my definition of a species A species is a community, or a number of related communities, the distinctive morphological characters of which are, in the opinion of a competent systematist, sufficiently definite to entitle it, or them, to a specific name Groups of higher or lower rank than species can be defined in a similar way Thus a sub-species is a community, or a number of related communities, the distinctive morphological characters of which are not, in the systematist's opinion, sufficiently definite to merit a specific name, but are sufficient to demand a sub-specific name Similarly a genus is a species, or a number of related species, the distinctive morphological characters of which entitle it, or them, to generic rank

There are, of course, many species so distinct from all others and so uniform throughout their range that every one is agreed about them, but frequently the limits and contents of a species, as of a genus, are a matter of opinion No systematist has, or should have, any rule as to the amount of difference required for the recognition of a species or a sub-species, he is guided by convenience In practice it often happens that geographical forms, representing each other in different areas, are given only sub-specific rank, even when they are well defined, and that closely related forms, not easily distinguished, are given specific rank when they inhabit the same area but keep apart

I have seen a species defined as a stable complex of genes—or words to that effect—and Bateson, without exactly defining a species, has insisted that those systematists who distinguish between good and bad species are right, and that the distinction between the two is not simply a question of degree or a matter of opinion There is some truth in this, in the absence of exact knowledge, seasonal or sexual differences have been regarded as specific, and hybrids, as well as varieties that differ from the normal in some well-marked character, have been given specific names these are certainly bad species There is truth also in Bateson's contention that species are qualitatively different from varieties, if we restrict this word to the kind of varieties he has specially studied and do not use it for communities that differ from each other in morphological characters

According to Bateson the principal qualities of species are morphological discontinuity and interspecific sterility, but to the implication that these have been suddenly acquired, I would reply that in Nature there is every gradation from communities that are morphologically indistinguishable to others that are so different that every one is agreed that they are well-marked species, and it is not surprising that when morphological differentiation has proceeded to this extent it should generally, but not always, be accompanied by mutual infertility That morphological discontinuity in a continuous environment which appears to Bateson to support the theory of the discontinuous origin of specific characters is seen to be the final term of a habitudinal discontinuity that began with the formation of communities that were at first morphologically identical Bateson's argument that the Natural Selection theory, or any theory of gradual transformation, demands that the ancestral form from which two species have diverged should persist as an intermediate is seen to be quite fallacious if we get a firm grip of the idea of the division of a species into communities, followed by the evolution of each community as a separate entity

A great deal of work has been done, especially on our more important food-fishes, in making biometrical analyses and investigating the life-histories of the different communities

I have studied with particular attention the fishes known as char, or salmonoid fishes of the genus Salvelinus Char are very like trout in appearance, but have orange or scarlet spots instead of black ones, they inhabit the Arctic Ocean and in the autumn run up the rivers to breed in fresh water, often forming permanent freshwater colonies in lakes There are many such colonies in the lakes of Scandinavia, of Switzerland, and of Scotland, Ireland, and the Lake District of England, the formation of these colonies must date back to glacial times, when these Arctic fishes occurred on our coasts and entered our rivers to breed These lacustrine communities show considerable diversity in habits and also in structure, for example, the char of Lough Melvin in Ireland are quite unlike those of Loch Killin in Inverness in form, in coloration, in the shape of the mouth, and in the size of the scales, these differences are sufficient to entitle them to be regarded as different species, and I have so regarded them, but now I doubt whether it is not better to look upon all these lacustrine char, however well characterised, as belonging to the same species as the migratory char of the Arctic Ocean, for once you begin giving specific names to lacustrine forms of char you never know where to stop But if we were to exterminate the char in the British Isles and on the Continent, except in a dozen selected lakes, we should have left a dozen well-marked forms which it would be convenient to recognise as species A somewhat similar problem arises in the classification of man, it is convenient to place all the living races in one species But if there were only Englishmen and Hottentots we should probably regard them as specifically distinct

In our British char, habitudinal segregation—the formation of communities in lakes—has been followed by a geographical isolation which commenced at the

[1] From the presidential address delivered at Southampton on August 28 before Section D (Zoology) of the British Association

end of the glacial period, when the migratory char retreated northwards The char of each lake have evolved separately and one can see clearly how many of the differences between them are related to the conditions of life, for example, the large eyes of the Loch Rannoch char, which lives in a very deep lake, and the blunt snout and rounded subterminal mouth of several kinds which always feed at the bottom I confess that I do not understand why the scales are much smaller and more numerous in the char of some lakes than in those of others, but I suspect that these differences in scaling are the expression of physiological differences, and are the result of differences in the environment or in the activities of the fish

The genus Salmo comprises about ten species from the North Atlantic and the North Pacific, and I have shown that the salmon and trout of the Atlantic form one natural group and those of the Pacific another Our own salmon and trout are two closely related species, both of them range in the sea from Iceland and northern Norway to the Bay of Biscay, both enter rivers to breed, and in both the young fish, known as parr, remain in fresh water until they are about two years old and six inches long, and then go to the sea From Mr F G Richmond, a well-known pisciculturist, I have the information that although at certain seasons the parr of both salmon and trout may eat the same kind of food—for example, both take flies at the surface—yet on the whole their food and feeding habits appear to be different Salmon parr seek their food, such as insect larvæ, small molluscs and crustaceans, on the bottom, whereas young trout tend to keep in mid-water and to subsist more on water-borne food, thus the salmon parr may be hunting for food in a stretch of shallow rapid water, while the young trout wait for it in the quieter water just below When they are about six inches long the parr of both species become silvery and are termed smolts, the trout smolts go to the sea in a leisurely manner, hanging about the estuaries, and the older fish frequent the coastal waters, but the salmon smolts make straight for the open sea and there grow much faster than the trout, attaining a weight of several pounds in a year

I have gone into these details because I think it is important to establish that two closely related species in the same area have different habits, and to a large extent avoid competing with each other

The morphological differences between salmon and trout are slight The salmon, more active and a stronger swimmer, is more regularly fusiform in shape and has a more slender tail and a more spreading and more deeply emarginate caudal fin, differences of the same kind but not of the same extent as between a perch and a mackerel The rows of scales between the adipose fin and the lateral line are usually fewer (10 to 13) in the salmon than in the trout (12 to 16), but this may be directly related to the fact that the tail is more slender On an average the salmon has one ray more in the dorsal fin than the trout, and I am tempted to regard this as a step towards that increased number and concentration of the dorsal rays which is so characteristic of swift-swimming pelagic fishes The last difference between the two species—the smaller mouth of the salmon—may be related to the food and feeding habits of the parr In structure as in habits the salmon is more specialised than the trout, and may have evolved from it The salmon is found on the Atlantic coast of North America, where there are no trout, but I think this is because its habit of going farther out to sea has given it a greater opportunity of extending its range There can be little doubt that the differentiation of these species has been not geographical but habitudinal, comparable to the differentiation of the coastal and open-sea herrings

In every river and lake that it enters, the trout forms freshwater colonies, and on the other side of the Atlantic the salmon does so fairly readily although not nearly so generally as the trout does on this side In Europe, trout being present, the salmon forms freshwater colonies only in exceptional circumstances Thus Lake Wenern in Sweden, now cut off from the sea by inaccessible falls, has a stock of salmon, there can be no doubt that in former times salmon entered the lake and bred in its tributaries, and that some of the smolts, when they reached the lake on their seaward migration, considered this very large lake a sufficiently good substitute for the sea to stay there, and so founded a lacustrine race

Freshwater colonies of trout are found in the Atlas Mountains and in the countries north of the Mediterranean eastwards to the Adriatic, proving that in glacial times the range of sea-trout extended southward to the Mediterranean The rivers of Dalmatia and Albania are inhabited not only by trout but also by fish of another species, known as *Salmo obtusirostris* This little fish, which never grows larger than fifteen inches long, has all the structural characters that distinguish salmon from trout, and, indeed, looks very like an overgrown salmon parr, but when compared with salmon of the same size it is seen to differ in having a considerably smaller mouth, weaker teeth, and more numerous gill-rakers (15 to 18 instead of 11 to 14 on the lower part of the first arch) In fishes generally the number and length of the gill-rakers—projections from the gill-arches that prevent food from entering the gill-chamber with the respiratory current—are related to the nature of the food, thus, in exclusively piscivorous fishes, such as the pike, they are represented by a few short knobs, and in feeders on minute plankton organisms they are very numerous, long, slender, and close-set It has been recorded that *Salmo obtusirostris* subsists mainly on the larvæ of Ephemeridæ, which are very abundant in the rivers it inhabits, and there can be no doubt that the small size of the mouth, the feeble dentition, and the increased number of gill-rakers are related to this diet

The presence of this fish in the rivers of the east side of the Adriatic seems to me to point to the probability that in glacial times salmon, as well as trout, occurred in the Mediterranean, and that in these rivers some of the salmon parr, tempted by the abundance of parr food, preferred to continue the parr life instead of going to the sea as smolts, thus forming a freshwater colony in quite a different way from the salmon of Lake Wenern The question may be asked If these fishes are derived from salmon and live in the same way as salmon parr, how can their differences from salmon be adaptive? The reply to this is that the size of the mouth in the salmon parr must have some relation to the fact that it is going to become a salmon, feeding on fishes in the sea,

and that, as *S obtusirostris* grows to twice the length of a salmon parr, we should expect the number of gill-rakers to be increased, for it is not number but the size of the interspaces that is important in relation to food

The work of Dr Johannes Schmidt on the viviparous blenny (*Zoarces viviparus*) is of great interest He found that samples of Zoarces from various parts of the Kattegat and Baltic differed slightly, but generally had an average of about 118 vertebræ, but that in the shallow Danish fiords the number was less, and decreased progressively the farther the distance from the sea Conditions of temperature, salinity, etc, are very different in the different fiords, and I am inclined to think that the critical character common to all of them is that they give the Zoarces an opportunity of leading a quiet life amidst a plentiful supply of food, hence the fiord Zoarces can be distinguished at a glance from those outside by their shorter and deeper form For example, in the Mariager Fiord, a narrow inlet about twenty miles long, the average number of vertebræ decreases from 115 at the mouth to 111 about seven miles inland and 110 about fifteen miles inland, two samples from the extreme end of the fiord and from a point four miles from the end both showed exactly the same average, 109 3

There can be no doubt that the fiords were originally populated from the outside, and it seems likely that the decreased number of vertebræ in the fiords is related to the lesser activity of the fiord fish Evolution has proceeded to such an extent that the Zoarces of the Roskilde Fiord differs from that of the Kattegat more than does the European eel from the American, and these are generally regarded as good species But the repetition of the same phenomenon in different fiords, and the continuous gradation from one form to another, make it impossible to recognise species here Zoarces are very stationary, but possibly the young are more migratory than the adults If we suppose that these fishes move on an average a mile a year, or even less, and mate with the nearest fish of the opposite sex, we can understand how the tendency to form a pure fiord race is hampered by continuous interchange, and how the influence of the outside form gradually diminishes until in the innermost waters it is not felt at all and isolation is accomplished In each fiord a series of intermediates, hybrids if we like so to term them, connect two well-differentiated communities, one in the sea, the other in the inner waters of the fiord

These detailed examples are sufficient to illustrate my view that some form of isolation, either physical or produced by localisation or by habitudinal segregation, is a condition of the evolution of a new species The effects of physical isolation, due to the formation of a barrier, are well seen in comparing the fishes of the Atlantic and Pacific coasts of Central America, most of which can be paired, one species being found on the Atlantic side and its nearest ally on the Pacific side The effects of habitudinal segregation are, as it seems to me, seen in the cichlid fishes of Lake Tanganyika, where there are ninety species that appear to have evolved in the lake from two ancestral forms, the differences between these species in the form and size of the mouth, and in the dentition, are an indication that their diversity is related to specialisation for different kinds of food

The whole of my work leads to the conclusion that the first step in the origin of a new species is not a change of structure, but the formation of a community either with new habits or in a new or a restricted environment For some species we know fairly certainly what has happened, and where, when, and why Shall we ever know how? Experimental attempts to repeat the operations of Nature might perhaps give us a clue, but I do not expect one from experiments of the kind that are so fashionable nowadays

For example, if *Salmo salar* and *Salmo obtusirostris* could be bred together, it would not matter much whether the hybrids were sterile or fertile, and if they were fertile it would not interest me to know that the variation in their offspring could be squared with the factorial hypothesis by the ingenious assumption that there were several factors for both larger mouth and smaller mouth and for fewer gill-rakers and more gill-rakers Even if the number of gill-rakers in either species could be increased or decreased by thyroid extract, I should still be unconvinced that we had got much nearer to the root of the matter

Throughout, the evolution of fishes illustrates the same principles Changes of structure have been intimately related to, and may even be said to have been determined by, changes of habits, and especially changes of food and of feeding habits Evolution has been adaptive, but modifications of structure that were originally adaptive persist when they are so no longer, they become historical and the basis for further adaptive modifications I am satisfied that these principles, which I have illustrated by examples from the group I have specially studied, have a general application

Darwin's theory of evolution was that it had been accomplished mainly by natural selection, aided by the inherited effects of use and disuse Whether that theory be permanent or not, it was put forward by a man pre-eminent for his wide knowledge and his great reasoning powers, who knew the facts that had to be explained and gave us a theory that explained them The "Origin of Species" still remains the one book essential for the student of evolution

Darwin has been criticised because, we are told, he did not know that there were two sorts of variations—mutations, which are inherited, and fluctuations, which vary about a mean and are not inherited But when you point out to a mutationist that the heredity of many fluctuating variations has been proved—parents above the mean, for example, giving offspring above the mean—he tells you that that shows that the variation is not really fluctuating, but only apparently so, and that a large number of "factors" must be involved This is in effect a complete withdrawal, for it amounts to an admission that Darwin was right if he considered that these types of variation differed only in size and frequency

There are other critics, however, who admit that at any rate some fluctuations are inherited but say that the effect produced on a population by selection is limited, elimination of certain types will change the average, but will produce nothing new This criticism has also, as it seems to me, been disproved experimentally, for example, by De Vries, who from two plants of clover in which a few leaves were four-lobed produced by selection a variety in which the number of

lobes of the leaves varied from three to seven, fluctuating about a mean of five. Incidentally this experiment shows the relation between mutations and fluctuations.

The criticism that many specific characters are non-adaptive merely amounts to this, that we do not know the meaning of many specific characters. Moreover, we are not likely to for a long time, for a prolonged study would be necessary to understand fully the meaning of the differences between any two species, to determine which characters were adaptive, which historical, which due to the environment, and which the expression of metabolic differences.

If these criticisms of the natural selection theory can be met, it does not follow that it is a complete theory. It may be a sufficient explanation of certain types of evolution, and one cannot wonder that those who have studied mimicry in insects are firmly convinced of its truth; but the evolution of the dodo and of the blind fishes of subterranean waters, put rather a strain on the theory and almost demand the recognition of the inheritance of the effects of use and disuse.

If this be admitted, if the adaptive responses of an organism to changed habits and changed conditions make it possible for subsequent generations to respond with greater effect, then the part played by natural selection in evolution of this kind would be subsidiary, the selection of those individuals who responded earlier or better than their fellows. How well this idea fits in with that fundamental generalisation, the law of recapitulation, which states that ontogeny tends to repeat phylogeny, and that the more remote the ancestor the earlier it will be represented in the developmental history! This generalisation, based on embryological data, has since received strong support from palæontological evidence.

Most people are aware that a flat-fish when first hatched is symmetrical and swims vertically, but that at an early age one eye migrates round the top of the head to the other side, and the little fish sinks to the bottom and henceforth lives with the eyed side uppermost. But perhaps it is not so well known that it has been shown that almost as soon as the fish is hatched the cartilaginous supraorbital bar above the eye that is going to migrate begins to be absorbed, and is eventually represented only by short processes of the otic and ethmoid cartilages, with a wide gap between them. Through this gap the eye migrates, with the result that, when ossification begins, the main part of one frontal bone is on the wrong side of its eye. The flat-fishes are an offshoot of the perch group, and it is known that some of these have a habit of resting on one side. If such a fish found it profitable to lie in wait for its prey in this position it would naturally try to make some use of the eye of the under side, pressing it upwards against the edge of the frontal bone. In the flat-fishes the migration of the eye into and across the territory of the frontal bone, prepared for by the absorption of the cartilaginous precursor of the frontal bone before the eye shows any sign of migration, may well be interpreted as the final stage of a process thus initiated.

You will have seen, then, that I am inclined to accept Darwin's theory as a whole, including both natural selection and the inherited effects of use and disuse, at any rate until some better explanation of the facts is forthcoming. But still there are difficulties, and to illustrate them I must give one more example from the fishes.

The most primitive spiny-rayed fishes are the Berycoids, which flourished in Cretaceous times; in some of these the vertebræ number 24—10 præcaudal and 14 caudal. In many families of Percoids not at all closely related to each other, we find this number of vertebræ is a constant family character; for example, all the genera and species of sea-breams (Sparidæ), red mullets (Mullidæ), chætodonts (Chætodontidæ), grey mullets (Mugilidæ), and barracudas (Sphyrænidæ) have 24 (10 + 14) vertebræ. The conclusion is inevitable that this is a primitive percoid character derived from a berycoid ancestor. Yet we have clear evidence that whenever the circumstances demanded it this number could be decreased or increased. There is no variation and therefore no material for selection; also the number of vertebræ is settled at a very early stage, and no fish can increase or diminish that number in its lifetime. Psettodes, the most primitive living flat-fish, has 24 (10 + 14) vertebræ; it is simply an asymmetrical perch. It has a large mouth and strong, sharp teeth, and its principal movements are probably short dashes after fishes that come near enough to be caught. But in other flat-fishes the number of vertebræ is greater: in the sole, which feeds on small invertebrates that it finds in the sands, and swims along with undulating movements of the whole body, the number is about fifty, and in the tongue-soles (Cynoglossus) there may be so many as seventy vertebræ.

We are almost compelled to believe that muscular movements, the efforts of a fish to swim in a certain way, may lead to an alteration in the number of muscle segments of its descendants; the number of vertebræ is, of course, determined by the number of muscle segments. This is an extension of the Lamarckian theory, and some may regard it as a teleological speculation unworthy of serious consideration; some may even think that, as my suggested explanation is incredible, we have here another example of the truth of the mutation theory, which in effect states that it is only by accident that a structure has a function.

Many biologists have adopted Weismann's germ-plasm hypothesis so whole-heartedly that they seem to regard it as a final disproof of Lamarck's theory. But when we consider that in progressive evolution, as in the development of the individual, increasing complexity of structure and localisation of functions is accompanied by co-ordination of the activities of all the parts, that differentiation and integration go together and the organism remains a unit, the so-called "inheritance of acquired characters" seems no more unlikely in the most advanced Metazoa than in the simplest unicellular organisms; and in some of these it has been proved.

When I read Huxley's essays as an undergraduate I was greatly impressed with his remark that "Suffer fools gladly" was very good advice. If a man does not agree with you, try to find out why he thinks as he does; you may discover the weakness of your own position. We should not adopt theories as creeds and denounce other theories as heresies. We are more likely to make progress towards the solution of the problem of evolution if we keep open minds and take broad views.

The British Association Connexion with Oxford

AT the close of the first meeting of the British Association, held at York in 1831, the assembly stood adjourned to Oxford, the Rev Prof William Buckland becoming president-elect Before the meeting dissolved, a speaker declared that in his opinion the Association was destined "greatly to enlarge the boundaries of science, and in so doing advance the many interests of human nature which depend upon the improvement of knowledge" It was all very tentative then, a matter indeed of faith, and faith sustained hope

The train was thus laid for the second meeting held at Oxford in 1832 Since that date three other gatherings have met in the city, namely, 1847 (Sir R H Inglis, Bart, F R S, president), 1860 (Lord Wrottesley, F R S, president), 1894 (the Marquis of Salisbury, K G, F R S, president) Next year, as we know, H R H the Prince of Wales will occupy the presidential chair at Oxford

Buckland, at the time of his appointment as president, was an enormous asset to the well-being of the first-born of York—a child able to walk, scarcely to run He was a fellow of the Royal Society, and a past-president of the Geological Society Moreover, he possessed agreeable social qualities, not least of which was a keen sense of humour He had a habit of carrying about with him a large blue bag, containing fossils Once, he said, he paid a visit to Sir Humphry Davy "Has Dr Buckland not called to-day?" inquired Sir Humphry "No, sir," said the servant, "there has been nobody here to-day, but a man with a bag, who has been here three or four times, and I always told him you were out"

Buckland's address upon taking up the duties of his office was brief, in no way comparable with present-day extended surveys He, however, gave a lecture on the fossil remains of the Megatherium Cuvier had died on May 13 in the same year, and Buckland took occasion to give eloquent expression to the loss sustained by the death of that illustrious naturalist and leader In the mid-week, at a general meeting, the first award of the Wollaston gold medal was made by Roderick Murchison, the president of the Geological Society, to William Smith, the acknowledged "Father of English Geology"

A voluminous report was presented by J F W Johnstone on the recent progress and present state of chemical science At an evening meeting Dr Ritchie delivered a lecture on "Magnetic Electricity," with reference especially to recent discoveries of Faraday Brunel gave an account of the attempt to carry a tunnel under the Thames

At a Convocation, honorary degrees were conferred on Sir David Brewster, Robert Brown, John Dalton, and Michael Faraday, a "hodge-podge of philosophers," commented Keble

Fifteen years had elapsed before the Association met again at Oxford in 1847 By then the permanence and stability of the organisation was fully assured, the boundaries of scientific effort advanced in all directions The chair was taken by Sir Robert H Inglis, member of Parliament for the University We may conclude that the latter qualification really led to his selection He was a politician, one who opposed the repeal of the Corn Laws, a country gentleman with a genial manner, and capable of making friends, one also who took great interest in learned and religious societies, but, as chronicled by his biographer, "with many prejudices and of no great ability" We get a glimpse of views entertained by the president of the wonder-working electric telegraph Sir Robert Inglis expressed regret that so great a discovery had been inadequately welcomed in Great Britain Yet in the discharge of public business was it not important? He had had an opportunity of examining the telegraph in the lobby of the House of Commons, by means of which communication passed to distant rooms He gave specimens of information thus conveyed "Committee has permission to sit until five o'clock", and among questions sent down were the following "What is before the House?" "Who is speaking?" "How long before the House divides?"

John Couch Adams, the discoverer of the planet Neptune, made personal acquaintance with Leverrier at this meeting, and both were Sir John Herschel's guests Leverrier's indications had supplied the basis for the location of the planet in 1846, but months earlier Adams had set down the data

Dr Schunck discoursed on colouring matters Edwin Lankester read a paper "On the Plant which yields Gutta Percha," and prophesied its application as probably "very extensive" Owen, too, was at the meeting, and Ruskin, as secretary of the Geological Section The youthful Huxley sent from H M *Rattlesnake* a paper on the corpuscles of the blood of *Amphioxus lanceolatus* Faraday exhibited three specimens of diamonds received from M Dumas, which had been subjected to intense heat Joule read a paper (the third) on the mechanical equivalent of heat, which was, remarks Mr Howarth, heard by both Faraday and Thomson (afterwards Lord Kelvin), the second of whom perceived that "it contained a great truth and a great discovery"

The Association did not return to Oxford until 1860, Lord Wrottesley becoming president For four years (1854–58) his lordship had occupied the presidential chair at the Royal Society, earlier (1841–43) that at the Royal Astronomical Society Hence he brought distinction and experience to his new office Lord Wrottesley's address dealt rather fully with astronomical subjects The important event of the opening of the New Museum at Oxford was referred to as an omen of bright hope in the diffusion of science It is well to go back upon the past and quote the president's remarks respecting practical applications of chemistry "We may refer," he said, "to the beautiful dyes now extracted from aniline, an organic basis formerly obtained as a chemical curiosity from the product of the distillation of coal-tar, but now manufactured by the hundred-weight in consequence of the extensive demand for the beautiful colours known as mauve, magenta, and solferino" In physiology, note was made of great and steady advances in the chemical history of nutrition, and of the electricity of nerves and muscles The recent return of McClintock from the search for Sir John Franklin

was alluded to The "Voyage of the *Fox* in the Arctic Seas" had been published late in 1859

Passing to sectional details, it is incumbent to recall two papers read at Oxford at this time, respectively by Dr Daubeny and Prof Draper, of New York Darwin's "Origin of Species" had appeared in 1859, of which by 1860 no fewer than eleven editions had been issued These communications offered but cautious approbation of Darwin's researches In itself, Draper's paper embodied an attempt to show that the advance of man in civilisation does not occur accidentally or in a fortuitous manner, but is determined by immutable law From his work on physiology, published in 1856, he gave his views in support of the doctrine of the transmutation of species, the transitional forms of the animal and also the human type, the production of new ethnical elements or nations, and the laws of their origin, duration, and death We must go outside the official Report of the Association for the year to piece together the records of the controversy and storm of words which waxed and raged round these communications, in a sense they were but stalking-horses, in any event traps for the unwary Yet, looking back upon this mixed chapter of scientific and clerical polemics, the happenings all seemed inevitable The stage was set, the disputants in place Prof Buckman sent a further report on experimental plots in the botanical garden of the Royal Agricultural College, Cirencester, while Lawes and Gilbert again entered the domain of classic inquiries with a paper on the "Composition of the Ash of Wheat grown under various circumstances" Capt Maury, of the U S Navy, had written to the president urging attention to Antarctic exploration, concluding cheerily with the words, "So trusting and hoping that you will join with me in the cry 'Ho for the South Pole!'" William Fairbairn reported experiments to determine the effect of vibratory action and long-continued changes of load upon wrought-iron girders

In 1894 the Association again chose Oxford, after what Lord Salisbury, the president, and Chancellor of the University, termed "a long and dreary interval of separation of thirty-four years" Consequently a new generation participated in the proceedings of the reunion The gathering was a great success, 2321 persons taking up membership, while no fewer than 77 foreign members attended, including Prof Mittag-Leffler, Prof Ludwig Boltzmann, Dr S P Langley, M Cornu, Prof E Van Beneden and Prof Strasburger One is painfully conscious in looking over the roll that time has brought about the removal of many eminent personalities in science since Oxford last received the Association

Certainly the most notable occurrence at the meeting was the announcement by Lord Rayleigh and Prof William Ramsay of the discovery of a new gas in the atmosphere—argon It fell to Sir Henry Roscoe to propose a vote of congratulation

The president's address was prefaced by the open confession that he was, after all, only a layman, and "all the skill of all the chemists the Association contains will not transmute a layman into any more precious kind of metal" Nevertheless, the discourse provided a distinctive summary of advances, and comments thereon In Lord Kelvin's view there was throughout "the spirit of the student, the spirit of the man of science" Prof Huxley seconded a vote of thanks It was reserved for an eminent mathematician and publicist to write later 'We find nothing in it which shows either the student or man of science, it teems with fallacious conclusions, and whatever may have been intended by the author, it can only serve as an appeal to the gallery, which is occupied by the reconstructed theological party"

In one of the sections Hiram Maxim gave a description of his experiments on flying by means of aeroplanes Mr Henry Balfour, in a paper on the evolution of the bow as a musical instrument, gave the aboriginal races of Africa and India the credit of providing the prototype of many of our best stringed instruments Mr Preece discoursed on signalling through space Sir Andrew Noble told of his methods for measuring pressures in the bores of guns, that the earliest attempt, by direct experiment, to ascertain pressures developed by fired gunpowder, was that made by Count Rumford, but Sir Andrew pointed out assumptions and erroneous determinations Lord Salisbury attended Prof Rucker's address in the mathematical section, afterwards an adjournment was made to the Clarendon Laboratory to hear Lord Kelvin describe experiments on the electrification of the air Prof H B Dixon president of the section of chemical science, took as his subject "An Oxford School of Chemistry" "If it be a true saying," he remarked, "that men here imbibe a liberal education from the very air breathed by Locke and Berkeley, surely we also may draw scientific inspiration from this air, not only breathed, but first explained, by Boyle, and Hooke, and Mayow"

Two evening lectures were delivered (1) by Dr J W Gregory, on "Experiences and Prospects of African Exploration", (2) by Prof J S Nicholson, on "Historical Progress and Ideal Socialism", the lecture to the operative classes was by Prof Sollas, on "Geologies and Deluges"

There was an overflowing attendance at the Sheldonian Theatre to hear Lord Salisbury's presidential address It seems that numbers of volunteer helpers were swept aside, through the determined inrush of visitors, and thus were unable to perform their functions An experience such as this will doubtless be borne in mind on the occasion of the meeting to be held next year T E JAMES

Recent Developments in the Theory of Magnetism [1]

By Prof C G DARWIN, F R S

THERE have been several important discoveries made in the theory of magnetism in the course of the last two or three years, and we shall discuss some of these, but in order to appreciate them it will be well to begin with a description of the general magnetic properties of matter All magnets can be typified by the ordinary bar magnet, which has a north pole at one end and an equally strong south pole at the other If such a magnet is cut in half, the north half grows a south pole at the section and vice versa In consequence of this we do not take the magnetic pole as the working

[1] Discourse delivered at the Royal Institution on Friday, May 15

unit, but the magnetic dipole. We imagine that each molecule of the bar has north and south poles, and that they are ranged end to end, so that all the middle ones cancel out and leave a free north pole at one end and a free south at the other. The measure of a magnet is then taken, not as the pole strength, but as the *magnetic moment*, which is the product of the pole strength into the length. The moment of the whole bar is the sum of the moments of its molecules.

There are two chief ways in which magnetic effects exhibit themselves. The first is that shown by a compass when it twists round so as to point along the direction of the earth's field. There is another effect which is very important, and to be distinguished from it, which arises when the field is not uniform. Then one end of the magnet will be pulled more than the other is pushed, and so the magnet will experience a force moving it bodily—this may be either an attraction or a repulsion. The first effect is usually easier to exhibit, but we shall be more concerned with the second.

Under the influence of a magnet all bodies become themselves magnetic, but there are three quite distinct types of behaviour. A piece of iron becomes strongly magnetic with a south pole next the north pole of the inducing magnet. Iron, nickel, and one or two other substances have this property to a high degree, but there are many others, for example aluminium, which show it feebly. For all these it is about a hundred-millionth less, and so a different name is used. Iron, etc., are said to be ferro-magnetic, the rest are called para-magnetic. If a paramagnetic rod is put between the poles of an electro-magnet, it becomes itself a feeble magnet with north pole next to the south pole of the inducing magnet. There exist many other substances, for example copper, having the opposite property. Facing the north pole of the electro-magnet there appears a feeble north pole. This property is called diamagnetism. The measure of the two properties is called *susceptibility*, and is positive for paramagnetic and negative for diamagnetic substances. It is found by making experiments in non-uniform fields. A paramagnetic substance tends to move into the strong field, a diamagnetic out of it. So a bar hung between pointed pole pieces will twist round towards the points in the first case and away from them in the second.

Magnetic action is exhibited by electric currents, as is typified by the galvanometer and every ordinary electrical measuring instrument. Now, in science one cannot admit that two radically different things can produce identical effects, so we are forced to conclude that either the current is really a magnet, or the magnet is really a current, and the second is certainly the correct alternative. In each iron atom there is a current circulating, and this current gives rise to its magnetic moment. We shall see now how this explains dia- and para-magnetism, taking for simplicity the supposition that we are dealing with a gas.

Suppose that we surround a cylinder of metal by a wire and then send a current through the wire. The current causes a magnetic field along the axis. At the moment of making, an eddy current will be induced in the cylinder in the opposite direction, but the frictional resistance to the flow of electricity will destroy this quickly. But if there were no friction (as is actually the case at very low temperatures) this current would persist indefinitely, and would exert a magnetic field weakening the other. This is exactly what diamagnetism does. So we say that the atom is something like a frictionless conductor. When a field is put on it induces opposing currents in the atoms, and these persist and exert a field opposing the external field.

We must next explain paramagnetism. We believe that every atom has the induced current of diamagnetism, but that this is overridden by a second property. Each atom of a paramagnetic gas has a magnetic moment, even when there is no field. If we could suppose them to be little bar magnets, they would swing to and fro in the presence of an external field, and would be oftener pointing down the field than up it. This would give an extra magnetic moment down the field and would be paramagnetism. Unfortunately the matter is not so simple as this, because the moment must be caused by a revolving electron, and this behaves quite differently. It may be likened to a top, which has the property of always moving at right angles to the direction in which it is pulled. So our atom will not go towards the field at all but will precess round it, and there will be no gain of magnetic moment in the direction of the field. In order to get this gain we have to allow for collisions between the atoms, for then the axes of the tops will be able to change, and will, in fact, have the tendency to point oftener towards than away from the field. The amount of the effect may outweigh the diamagnetism which is always present. The phenomenon shows a clear sign that it depends on collisions, for whereas diamagnetism is constant, paramagnetism depends on the temperature. When the gas is hot, the violence of the collisions makes nearly as many molecules point away as towards the field, but when it is cold the gentle collisions allow them nearly all to settle down along the field.

There is a most difficult point in the argument which is rather too abstruse to explain in detail. It turns on the proper way of taking the averages of the moments of the atoms. This must be carried out with the greatest rigour from dynamical principles. In the past many writers tried to make short cuts and obtained a variety of results. Some proved there could be no paramagnetism, some no diamagnetism, and some even that there could be neither. The essential point of the argument is that the atom must have somewhere the property of a top, which goes on spinning at the same rate however its axis may be altered. It must, so to speak, be able to remember for an indefinite length of time how it behaved when the field was first put on. At least that is how the matter stands on the classical theory. But, as we shall see later, there is definite experimental evidence which shows that the atom is only allowed to exist in a certain very limited number of states, and this rather eases the difficulty; for it need no longer remember its past history, but instead must conform to a rule, unexplained it is true, but in general conformity with other unexplained properties of matter.

The question arises as to whether there would be any way of observing the magnetic moment directly. Such a way was suggested by Stern about three years ago, and the experiment which he carried out in conjunction with Gerlach is certainly one of the most remarkable

of the present century. In a vacuum an atom of gas will go in a perfectly straight line until it hits the wall. If a source of atoms is in line with two fine slits, they will all hit the opposite wall in a narrow line. The atoms were obtained by boiling silver in a small furnace. Those which get through the slits strike the wall and stick there. Even after four hours nothing is visible on the glass, but there exist chemical methods of development whereby the invisible trace of silver attracts more silver from the developer and becomes visible. Now suppose that in their path the atoms encounter a non-uniform magnetic field. In the gaseous form the atoms of silver have a magnetic moment, and so they will experience a deflecting force. If the atoms were pointing arbitrarily in all directions, the character of the field shows that the fine line of the image should be spread out into a lens-shaped figure. What is in fact observed is quite different; the lens is there but it is hollow. The atoms are all pointing straight towards or straight away from the magnetic field.

This result would have been astonishing twenty years ago, but as a matter of fact the experiment was tried with a fairly strong expectation that it would turn out as it did. The quantum theory has illuminated many branches of physics, but none more than spectroscopy, and in particular it describes with complete success the influence of magnetic fields on spectra. According to this theory the atom is a very definite structure, and the definiteness extends not merely to size and shape, but also to its direction in space. The theory goes further and indicates that an atom ought to have a definite magnetic moment, which is called the "Bohr magneton," or in some cases a simple multiple or fraction of this. In silver the deflexion corresponds exactly to one magneton. Several other substances have since been measured, and most of the effects explain themselves on the same principles. Modern physical theory has to face a great many difficulties, and one of the severest is to explain how it is that half the atoms can point away from the field. Each atom evaporates in the furnace right outside the magnetic field and pointing in an arbitrary direction. As it enters the field, if it is to point away, it must gain energy, and there is nowhere from which the energy can come. This would have been a severe difficulty a few years ago, but dynamical toleration has grown recently, and it is becoming recognised as a probability that energy is only conserved on the average and not exactly.

The older calculations of para- and dia-magnetism depend essentially on assuming that the atoms can point in any direction, and they go wrong if this ceases to be true. We know it to be untrue in Gerlach's experiments, and the question arises as to whether it is true in other cases. This is the subject of some very remarkable recent experiments by Glaser. The susceptibility of gases is very small and hard to measure unless the gases are compressed. Glaser has perfected the arrangements of one method of experiment to such a high degree that he could measure the effect for very low pressures. The principle of his experiment can be described by analogy with the question of buoyancy. If a body is weighed in air and in water, the difference of the weights measures the weight of the displaced water. If a different liquid is used, a similar weighing will give its density in terms of water. Glaser takes a light rod of some substance, actually a slightly paramagnetic glass, and suspends it in a non-uniform field. In a vacuum the field twists the rod round by a definite amount. If it is surrounded by a gas which is also paramagnetic, it will not experience so great a twist, because it will, so to speak, be partly floated by the gas. Similarly, if the gas is diamagnetic, it will be more twisted than in a vacuum. The effect is very small and by no means easy to obtain, but by measuring the amount of twist a value can be found for the susceptibility. The diamagnetism stays constant down to a fairly low pressure, and then changes over to a larger value—actually three times as great. The work is very recent, and the theory is still more or less unknown. Superficially the phenomenon is rather like that of Gerlach, but a little deeper consideration shows that no very close analogy can be drawn between the two cases.

It is natural to suppose that the collisions between the molecules are somehow responsible for reducing the susceptibility at high pressures; but there is great difficulty in seeing how it comes about, for it must be remembered that even at high pressures a molecule is in collision for only a small fraction of the time it spends between collisions. Moreover, though it might be possible to explain in this way a change of susceptibility, there seems no chance of getting a factor so great as three to one. No doubt there will soon be more experiments to help us. For example, much could be deduced if we knew how the curves varied for different temperatures; and it would also be most interesting to know how other gases behave, in particular the strongly paramagnetic oxygen. Unlike the work of Stern and Gerlach, Glaser's experiments do not seem to fit in with the general scheme of things, and so we may perhaps hope that they will lead to some surprising new developments in physical theory.

Obituary

MR. W. E. CUTLER.

WE regret to have to record the death, on August 30, of Mr. W. E. Cutler, the field palæontologist who was working in Tanganyika Territory for the British Museum on the Dinosaur-bearing beds near Lindi. Those who lead sheltered lives in Europe are sometimes apt to overlook the arduous character of the work on expeditions in tropical or arctic lands, where either endemic disease or extremes of temperature endanger human life, and we may venture to refer to an article in these columns on April 18, p. 573, of this year, in which it was pointed out that the region in which these wonderful relics of an ancient fauna exist is pest-ridden to an unusual degree.

Mr. Cutler was a Londoner by birth, but emigrated to Canada with his parents at an early age. As a young man he became attracted by fossil collecting, and for some time it is believed worked in that wonderful natural museum which exists in Wyoming; later on he made some fine collections from the Cretaceous beds of Alberta and elsewhere. He served with the Canadian forces during the War, and then returned to

his adopted land to make collections for the University of Manitoba from the Ordovician beds of western Canada He was about fifty years of age at the time of his death He lived solely for his work, and had in the intervals of his collecting learnt a great deal about the anatomy of the creatures he sought for

Brought up in a hard school, Cutler prided himself on going anywhere with a minimum of kit and the simplest of food, and it came as somewhat of a shock to him when he was equipped for the East African Expedition to find that his impedimenta contained tents, camp beds, mosquito nets and the like He was impatient of such things, and inclined to look upon them as unnecessary luxuries which would need attention and therefore hinder his work Maybe if he had more fully recognised the danger of the insidious Anopheles, he would have been spared to carry on his work

Cutler's labours have been productive of fruitful results, and it is said that more than 600 bones have been collected, some of which have arrived, others being ready for despatch, and it will give some idea of the magnitude of the task when we learn that they will fill at least 120 cases All these have been personally excavated and prepared for despatch by Mr Cutler with the help of a few untutored natives—no mean task! They have, of course, not yet been worked out systematically, but it has been determined that bones of both armoured and probably carnivorous dinosaurs as well as herbivorous species are among the specimens Such an enthusiastic worker will be hard to replace, but the work must go on, for what has been achieved only demonstrates the magnitude of the task and its importance May this sad loss in the front line stimulate the public to support the expedition and enable it to continue with a staff much strengthened and supplied with every safeguard which the science of tropical hygiene can provide C W H

We regret to announce the following deaths

Dr Hans Bunte emeritus professor of the Technical Highschool in Karlsruhe, well known for his work in connexion with the German gas industry, on August 17, aged seventy-seven years

Prof Ernst Erdmann, director since 1922 of the Institute for Applied Chemistry at Halle, on August 19 at Rattvik Sweden aged sixty-eight years

Prof Georg Klien director for more than forty years of the East Prussian Agricultural Institute in Konigsberg, on June 23, aged seventy-six years

Prof Otto Lummer, director of the Physical Institute of the University of Breslau, whose investigations dealt with interference phenomena and with the estimation of the sun's temperature on July 7, aged sixty-five years

Dr Rudolf Martin, professor of anthropology in the University of Munich and an honorary fellow of the Royal Anthropological Institute, on July 11, aged sixty-one years

Dr Mansfield Merriman, professor of civil engineering at Lehigh University from 1878 until 1907, who was a pioneer in the development of technical education in the United States and also was distinguished for his work on mechanics and strength of materials, on June 6 aged seventy-seven years

Current Topics and Events

Sir Daniel Hall, in the course of his presidential address to the Conference of Delegates of Corresponding Societies at the Southampton Meeting of the British Association, appealed for their help in studying the antiquities of the land and of farming He pointed out that the opportunities in local societies for the study of natural history and archæology are rapidly becoming smaller, and even in such fields as botany and zoology the development of science is rapidly decreasing the sphere of activity available to the non-professional man He therefore suggested that such individuals can profitably turn their attention towards recovering, before it is too late the detailed agricultural history of the country The Corresponding Societies can give invaluable help in discovering the original settlement of the land, the manors, the system of cultivation adopted before enclosure and the date and method of enclosure The need for this work has been made all the more urgent by the Law of Property (Amendment) Act of 1924, which practically does away with the manor as a legal entity, and by the recent sales and breaking up of many of the great estates Title deeds and estate records in the hands of manor stewards, family solicitors and the like, may therefore become distributed and increasingly difficult to trace In this connexion a request from a Society to be allowed to examine these records will carry far more weight than one from a private person In addition, much useful information could be obtained in some districts by a close study of vestigial physical traces of the old farming and by the examination of field names referring for example, to crops that have now disappeared Again the preservation for local museums of old farming implements would be a valuable activity of a local society Apart from the intrinsic interest of this work, it would find a useful and highly desirable application in country schools A series of parish maps showing the change in agricultural customs, distribution of land vegetation, and so on, would provide excellent material for showing how, in response to physical and changing economic environments, the present farming system has slowly grown up from its simple beginning far back in the past

Among the interesting exhibits shown in Section B (Chemistry) during the session devoted to the ignition of gases at the recent meeting of the British Association at Southampton were the photographs taken at Sheffield by Prof Wheeler and Mr O Ellis on behalf of the Safety in Mines Research Board By arranging a camera to open at regular short intervals, they have been able to photograph the successive positions occupied by flames produced by the firing of explosive mixtures of methane and air in closed spherical and cylindrical vessels When the gas was fired by a spark in the centre of a glass sphere, the successive

images of the flame can be seen advancing uniformly so that the flame reaches the boundary simultaneously at all points, except for very slow flames, the effect of convection currents is inappreciable Some of the photographs first exposed when the flame had reached the walls of the vessel show not only the ring of light outlining the circular image of the sphere but also a re-illumination spreading outwards from the centre of the sphere This after-burning affords a neat proof that the chemical action is not completed by the apparent passage of the flame through an explosive mixture The illumination is due to pressure-waves reflected from the spherical surface meeting at the centre and increasing the rate of the residual combustion The phenomenon may be compared with the intense reflected waves sent back from the closed ends of short narrow tubes when the explosion-wave has not quite time to develop before the flame reaches the ends Other photographs were shown in which the flames were started at the top the bottom and the side of the sphere Such asymmetric ignition results in a retardation of the development of pressure and a lower maximum pressure compared with central ignition When the gas was ignited in a cylinder the flame progresses regularly until it touches the walls, then it appears to be squeezed slowly into the corners The photographs have been reproduced in *Fuel in Science and Practice* 1925, 4, 356

THE Southampton meeting of the British Association came to an end on Wednesday, September 2, with a meeting of the General Committee, at which votes of thanks were passed to the mayor and corporation, local committee, officers, and all who had contributed to its success by their support and hospitality At the meeting of the General Committee held on August 28, a deputation from Leeds attended to invite the Association to hold its meeting there in 1927, and the invitation was cordially accepted The date of the Oxford meeting next year, at which the Prince of Wales will be president, is to be August 4-11 The following vice-presidents of the Association nominated from Oxford for the Oxford meeting have been appointed The Chancellor of the University the Vice-Chancellor of the University, the Mayor of Oxford the Lord Lieutenant of Oxfordshire, the Bishop of Oxford, the Dean of Christ Church Sir Charles Sherrington, Lord Valentia, Dr Gilbert C Bourne Dr G Claridge Druce, Prof E B Poulton, Mrs G H Morrell, Sir Arthur Evans Prof H H Turner and the Principal of University College Reading The local officers for the meeting are *Treasurer*, Mr B Rowland Jones *Secretaries*, Dr F A Dixey and Brigadier-Gen H B Hartley The new members of Council of the Association are Prof A L Bowley, Dr H H Dale, Sir Richard Gregory, Prof T P Nunn, and Prof A O Rankine

POPULAR interest in natural history is on the alert The records of museums, popular lectures, public libraries press articles and natural history publications generally, even the upshoot of the "fundamentalists' all show that interest has been aroused in life and its workings Here are evidences which the man of science cannot afford to ignore for a widespread knowledge of the methods and discoveries of science must result in a fuller appreciation of scientific method and in the formation of a mass opinion which will thrust new power into the hands of the scientific worker But the position also demands that science in its popular presentation shall be progressive The day of the simple chronicle of the obvious has passed and it is needful that the plain man should learn something of the more profound relationships and interpretations which now engage the investigator Further the people cannot safely be left to gain their impressions of the aims and conquests of science from the cheap trifles of the dilettante the simple rendition of the subtleties of modern research whether it be in the written word or in the museum exhibit demands the application of the trained and fully stored mind

BECAUSE of these things "The New Natural History by Prof J Arthur Thomson (London George Newnes, Ltd, 1925 To be completed in about 20 fortnightly parts 1*s* 3*d* net each part), deserves a warm welcome The first part which has recently been received suggests that the work is to take the form of a series of short unrelated essays dealing with various aspects of the manifestation of life in the present 48 pages are compressed brief accounts under the headings of man s relations with other living creatures the web of life animal behaviour, the ways of monkeys, the beauty of life, the story of the bower bird, everywhere there are fitnesses everything in the light of its history, the hand of the past In view of Prof Thomson's own previous work and of the best popular natural history of the present day, the treatment is not strikingly "new," but it is new in the sense that it discards the stilted systematics of the past and emphasises the trend of modern zoology towards a fuller appreciation of the biological significances of structure habit, and development The work is to be completed in about twenty fortnightly parts Should it share the success which met the earlier "Outline of Science" in Great Britain and in the United States it will exercise a wide influence in moulding popular knowledge of the attainments of scientific investigation of animate nature

THE fourth autumn lecture to the Institute of Metals was delivered on September 1 by Sir John Dewrance on "Education Research, and Standardisation' Using the word 'education' in its broader meaning of education of the human race, Sir John emphasised the superiority of scientific method and of wisdom over mere knowledge, and asked for greater appreciation of those who have discovered new truths and made them available to mankind Men with original minds should be spared from the necessity of earning a living by doing inferior work, but private benefactions for the furtherance of research being still inadequate, although increasing, the assistance of the State is imperative After reviewing the main activities of the Department of Scientific and Industrial Research, and, in particular, those of the

National Physical Laboratory, Sir John Dewrance discussed the meanings of the words research, discovery and invention, pointing out how closely they are interwoven, and urging a wide acceptation of "research" so as to include such activities as the designing of a new type of submarine or the devising of a new method of production in a factory

With regard to the use by Sir John Dewrance of the word "research" to cover historical studies it may be pointed out that the business of the historian is not, strictly speaking, to discover new facts but to resurrect old It is true that he uses the scientific method and, like the investigator of Nature, frames views or hypotheses to correlate observations and immediate inferences from them but in view of the circumstance that although his interpretation may be new, his facts are necessarily old, there is a distinct difference between them and creative scientific research Sir John Dewrance proceeded to describe the enormous amount of work involved in devising standards The British Engineering Standards Association formed in 1901, is controlled by a main committee which presides over 400 sub-committees of engineers and other experts who give their labour gratuitously, and it is pleasing to hear that in a recent letter the Prime Minister expressed his appreciation of the valuable work done by the Association and his confidence in the application of its methods to the study of production costs, which is one of the most pressing industrial problems of the day In Sir John Dewrance's view, the character of virtue is best seen in the life of an intellectual man devoted to the service of truth The status of the discoverer and research worker is being gradually raised, and he hoped that his lecture would hasten progress "All who have benefited by knowledge should feel it a duty to do something for the acquisition of further knowledge"

In the early hours of September 3 the great United States airship *Shenandoah* was destroyed by a storm which broke the vessel into three pieces The *Shenandoah* was noteworthy in that its gas-cells were filled with helium instead of hydrogen, and details of its structure were given in an article in Nature of March 1 1924, p 313 It would appear that on September 3 the airship was travelling at an altitude of about 3000 ft near Cambridge Ohio, and according to a telegram to the U S Navy Department by Commander C E Rosendahl, the senior surviving officer of the airship, a mild storm was followed by a sudden line squall which caused enormous and uncontrollable angle strains and a rapid vertical ascent This resulted in the ship's structure breaking when it got to a height of about 7000 ft It is suggested in a message from the New York correspondent of the *Times* that the sudden rise of the airship caused undue expansion of the helium containers, straining the strut wires and girders and cracking the frame work Capt Anton Heinen is quoted as stating that the disaster was indeed due to this cause, and that the number of safety-valves in the *Shenandoah* were insufficient to permit of the rapid release of gas necessary when a sudden ascent is made

The following Royal Commission has been appointed to inquire into and report upon the economic position of the coal industry in Great Britain and the conditions affecting it and to make any recommendations for the improvement thereof Sir Herbert Samuel (chairman), recently High Commissioner in Palestine, Sir William Beveridge, Director of the London School of Economics, General the Hon Sir Herbert Alexander Lawrence, a managing partner of Glyn, Mills Currie and Co, and Mr Kenneth Lee, chairman of the British Cotton Industry Research Association and of Messrs Tootal Broadhurst Lee and Co, Manchester The following are to act as expert assessors Mr William Brace, Chief Labour Adviser to the Mines Department, Dr Walcot Gibson, formerly of the Scottish office of the Geological Survey of Great Britain, Major H M Hudspeth, one of H M Divisional Inspectors of Mines, and Dr C H Lander Director of Fuel Research, Department of Scientific and Industrial Research The secretary of the Commission is Mr C S Hurst Assistant Under-Secretary, Mines Department

A provisional programme has been issued of the second conference of the Association of Special Libraries and Information Bureaux to be held at Balliol College, Oxford, on September 25-28 The first session will be opened by Dr R S Hutton, chairman of the conference, who will describe the present position of the Association, and in the general discussion which is to follow, Mr A E Twentyman and Prof F E Sandbach will speak On the following day, the morning session will be divided between two discussions, on the special library movement in America and the Institut Internationale de Bibliographie, Brussels respectively, while the afternoon will be devoted to papers on abstracting, cataloguing, indexing and filing A discussion in the evening will show the relation of special libraries and information bureaux to the Press Meetings will be held on Sunday, September 27 in the morning and evening, at which the relation of special libraries to patents, science, medicine, education, transport and other aspects of modern life will be discussed

Applications are invited for the following appointments on or before the dates mentioned The Dutton memorial professorship of entomology in the University of Liverpool—The Registrar, The University, Liverpool (October 1) Two chemists at the Naval Ordnance Inspection Centre, Holton Heath, Dorset—The Secretary of the Admiralty (C E), Whitehall, S W 1 A biologist at the Kirton Agricultural Institute, Boston, Lincs—The Principal A cancer research worker at the Radium Institute—J C Mottram Research Laboratories, The Radium Institute, 16 Riding House Street, W 1 Lecturer in mechanical engineering—Agent-General for Western Australia, Savoy House, Strand, London, W C 2

Research Items

THE MAYAN CALENDAR —An interesting contribution to the discussion of the calendar of the ancient inhabitants of Central America and its possible correlation with Christian chronology is made by Mr J E S Thompson in *Man* for August Spinden, in his new scheme of correlation, has made the Mayan New Year Day fall on the winter solstice, which he says was arbitrarily chosen to initiate the calendar But the names of the Mayan months appear to contradict his theory Although data relating to the annual routine in agriculture of the pre-Spanish Maya are absent, it is justifiable, in view of their innate conservatism, to assume that modern Mayan customs give a fairly clear idea of the routine of their ancestors When the agricultural operations are taken month by month, it is found that each of these is faithfully represented by the names of the month in the calendar For example, in December and January the virgin bush is cut down, the scrub is left to dry until May, when it is burnt, whereupon the Mayans leave their villages to take up their residence in their *Milpas* (allotments) Then come the heavy, late spring rains, softening the ground, and sowing follows In the Mayan calendar as given by Landa, *Mol* corresponds to December 12 meaning to pile or collect together, *i e* the brushwood was piled *Ceh* or *Cel*—roasted, March 2 refers either to the burning of the brushwood or the condition of the soil after drought *Muan*, May,—showery *Pax* (May-June), to take possession, referring to the removal to the Milpas, and so on Any correlation which does not conform to the naming of the months, such as Spinden's in making *Cumhu*, the sowing season, and *Pop*, maize leaves mid-winter instead of June and July must be rejected

PALÆOLITHIC MAN IN MORAVIA —The third instalment of the Abbe Breuil's survey of palæolithic sites in Central Europe which appears in Pt 3-4 of Vol 35 of *L'Anthropologie* deals with the Moravian caves, of which the most important are Kostelik and Kulna At Kostelik, which is in the neighbourhood of Brno, the fauna is that of the mammoth and the reindeer Notwithstanding the absence of stratigraphical evidence, some of the stone implements can be attributed with some certainty to the Acheulean-Mousterian others belong to the Aurignacian and beginning of the Solutrean , others again are of a generalised upper palæolithic type and are to be assigned with some probability to the Magdalenian Certain remarkable objects made from the jawbones of horses, which have been described ineptly as carvings representing fish, are in reality a kind of ornamented knife in which the curved part of the jaw without teeth has been utilised to form a handle Both sides of the blade and handle are closely covered with an ornamentation of parallel curved lines alternating with short strokes and big dots In some cases they are combined to form a very simple decorative *motif*, such as a group of chevrons, while in one case this may be a sketch of an animal's head The remainder of the bone implements are Magdalenian, probably of various periods A postscript describes a small statuette of a mammoth in clay found near Unter-Winternitz in 1924

EYE FATIGUE —In the Journal of the Franklin Institute (August 1925), Mr Percy W Cobb and Mr Frank K Moss give the results of some experimental work on eye fatigue in its relation to light and work The problem of lighting is one of outstanding importance in industrial work when work can be performed by daylight the problems are relatively simple, but as soon as artificial light has to be used new factors intervene With the higher intensities of illumination people are apt to complain of eye fatigue The laboratory experiments described in this article were an attempt to study the effect produced by visual operations under different intensities of illumination An ingenious test was devised as a means of fatiguing the eye—and incidentally the attention—and the effect of the different intensities was measured by comparing the changes in the muscle balance of the subject before and after the test The test itself, worked for 30 minutes did affect the muscle balance significantly, but the change in the intensity of the illumination showed no significant difference either with regard to the amount of work done or the effect on the eye The conclusion, though, cannot be expressed by the general statement that the higher intensity was in no way harmful or tiring to the eyes of the worker , all that can be said is that, under these conditions no appreciable effect could be observed The eye fatigue cannot be estimated apart from the effect of attention, and industrial conditions introduce still more complications

INSECTS OF THE SWISS NATIONAL PARK —Volume 60 (1924) of the *Denkschriften* of the Swiss Natural Science Society consists entirely of the second and third instalments of the results obtained under the Commission appointed by the Society for the study of the fauna of the Swiss National Park in the Lower Engadine The Hemiptera and the Collembola are dealt with in the volume before us Dr Hofmanner began his special investigation in 1918 in company with Dr R Menzel, but lost that valuable colleague on his being called away for special entomological work in Java His account of the Swiss Hemiptera deals with the Heteroptera and the Cicadine group of the Homoptera Including previous records, and not adhering strictly to the confines of the National Park, he finds the list of Heteroptera to comprise 113 genera, 181 species and 6 varieties, while the Cicadinæ number 81 species and 15 varieties distributed among 28 genera The most interesting conclusion arrived at is that the Hemiptera of the Lower Engadine are somewhat southern in character, and have a marked affinity with the fauna of the South Tyrol Dr Handschin's researches into the Collembola of the National Park have been very fruitful He adds to the list of 65 hitherto recorded Swiss species no fewer than 30 species, of which 7 are new to science Moreover, the abundance of his material has enabled him to show that several forms regarded as specifically distinct are in reality only colour variants Thus he is led to suppress *Entomobrya lanuginosa* and *E nicoleti* with its two varieties *muscorum* and *obscura*, all of which he finds to belong to the very variable species *E nivalis* Both authors give full details of horizontal and vertical distribution, and the plates are adequate Altogether this instalment of the results of the Commission forms a handsome volume

THE COLEOPTEROUS FAMILY BRENTHIDÆ —*Indian Forest Records* (Entomology Series), vol 11, Part iv , 1925, is devoted to studies on some Indian beetles of the family Brenthidæ Herr Richard Kleine describes a number of new genera and species from British India and the neighbouring regions, bringing up the total number of known members of the family to 240 species Dr C F C Beeson contributes an article on the biology of the family and its relations to forestry This paper is the most important yet published on the subject and adds very considerably to what little was previously known The family is divisible into two

groups—(*a*) phytophagous, and (*b*) myrmecophilous, the latter only containing a few species As regards group (*a*) Dr Beeson s observations suggest that the Indian species (at any rate) are true wood-borers in the larval state and that their habitat is normally in felled or fallen timber and not in living trees The adult beetles occur gregariously between the bark and wood of trees that have been attacked by bark and sapwood-boring larvæ (mainly Longicornia) The myrmecophilous species include symphilines living in association with ants, while others are robbers Mr J C M Gardner describes the larvæ of two species of Cerobates and the pupa of *Cyphagogus corporaali* Kleine The larvæ show characters common to the Rhynchophora, *e g* their curved form, the vestigial antennæ, the continuity of the mentum and prothoracic cuticle, etc The presence of evident though minute thoracic legs is not incompatible with these affinities since many curculionid larvæ exhibit reduced ambulatory tubercles

INDIAN LIMNÆIDÆ —The last memoir from the hand of the late Dr Annandale forms a revision of the recent Indian Limnæidæ, in which H S Rao collaborated (Records Indian Museum vol 27, Part 3, May 1925) The authors have offered this paper as a means of identifying the species of Limnæa found in the Indian Empire They have had the advantage of studying the largest collection of shells and of material preserved in spirit ever accumulated from any oriental country and they have had good opportunities of noting the range of variation They discuss the characters of the jaws, radulæ, shell and genitalia, and after concisely describing 21 species and their forms," they provide a tabular key to the living species known from the Indian Empire and its immediate frontiers and a table of measurements of their shells In Part 1 of the same volume is an obituary notice of Dr Annandale and a list of his publications, which occupies 21 pages, it indicates the extraordinary range of his interests and the activity of his mind and his pen

THE BOGHEAD COALS —The United States Geological Survey has published an interesting paper (Professional Paper 132-I), by Reinhardt Theissen, on the origin of the Boghead coals This paper is a careful study of that group of coals which passes into true coal on one hand and into shale on the other, including, therefore the substances usually spoken of as bituminous shales, oil shales, cannel coals, etc The author shows that the yellow bodies characteristic of boghead coals are algæ of a somewhat unusual form the name Elæophyton has been suggested for this organism, and its structure has been worked out in considerable detail The paper is all the more interesting because it is practically contemporaneous with the work by Prof Jeffrey of Harvard University, lately noticed in these columns, who discusses these bodies at considerable length, and proves quite definitely to his own satisfaction that the bodies in question are spores and not algæ It is however clear that Prof Jeffrey knew nothing of Mr Theissen s work

INDIAN METEOROLOGY —The meteorology of India was dealt with by Sir Gilbert T Walker, professor of meteorology, Imperial College of Science and Technology, in a paper read at the Royal Society of Arts on May 8, and published in the Society's Journal of July 31 As Sir Gilbert was chief of the Meteorological Department in India for more than twenty years, and until quite recently, many points of considerable interest were referred to The characteristic feature of the south-west monsoon is explained, and the three weeks' journey of the air over the sea before it reaches India is said to afford time for air dry at its origin to become saturated with moisture to a considerable height, which is necessary to supply such rainfalls of 30 to 40 inches in a day, which occur in the western ghats and the corresponding hills near the Burma coast, combined with moderately heavy rain inland Work carried on for the last forty years by Blanford and Eliot, and later by the author of the paper, with the view of forecasting the monsoon rains by the assistance of data in various parts of the globe, is explained The difference between the air motions producing abundant and scanty rainfall is associated with marked differences in the conditions over a large part of the earth s surface Abundant Indian rains are associated with low pressure in India, Java Australia, and South Africa and with high pressure in the Central Pacific and South America The warning for storms at sea is assiduously carried out, and warnings are issued of the danger of sunstroke or heat apoplexy when the wet bulb temperature approaches 85° F

A LABORATORY OZONISER —A laboratory ozoniser, capable of yielding high concentrations of ozone (15 per cent), is described by L I Smith in the July issue of the Journal of the American Chemical Society The capacity of the ozoniser is more than 4 gm of ozone per hour The apparatus consists of three modified Brodie tubes made of soft glass connected in series and mounted in a large battery jar All connexions which come in contact with ozone are arranged so as to be made through mercury seals The battery jar is filled with distilled water, and serves both as an electrode and for cooling purposes Owing to the high voltage used (about 8000) the resistance of the water is negligible, and thus there is almost no heating effect a metallic cooling coil, however, is also immersed in the jar The electrode inside the tube consists of mercury Some observations on the action of various reagents on ozone are also recorded These fall into two groups (1) substances having only a very small effect, *e g* water, concentrated sulphuric acid, phosphorus pentoxide resublimed in oxygen and (2) those having a great effect, destroying much or all of the ozone, such as ordinary phosphorus pentoxide and 5 per cent sodium hydroxide solution

DECOMPOSITION OF SULPHURYL CHLORIDE —A paper by D F Smith in the July issue of the Journal of the American Chemical Society records some observations on the thermal decomposition of sulphuryl chloride This is a first-order homogeneous gas reaction Only one other such reaction is known, namely the thermal decomposition of nitrogen pentoxide, investigated by Daniels and Johnston (1921) The data obtained for sulphuryl chloride fit the theoretical equations put forward by Trautz and Bhandarkar (1919) No theory of reaction rate yet proposed, however, fits in with the observations made in *both* of these reactions, so that none of these theories is of general application

HYDROBROMIC ACID IN ACIDIMETRY —The composition of an aqueous hydrochloric acid solution which boils at a constant temperature is sufficiently definite to permit its use as a standard solution in acidimetry (Hulett and Bonner, 1909) D T Ewing and H A Shadduck have published a paper in the Journal of the American Chemical Society for July, showing that hydrobromic acid solutions may be used for the same purpose The constant-boiling acid boils at about 125° (760 mm) and is 5 9061 *N* by weight It contains 47 795 per cent HBr

Mosquito Control

OPENING OF A NEW INSTITUTE AT HAYLING ISLAND

A NEW phase in the control of the mosquito problem was reached last week when members of the Section of Zoology of the British Association attended the opening of the British Mosquito Control Institute which has been founded and equipped by Mr. J. F. Marshall in his own grounds at Hayling Island, Hants.

The new building (Fig. 1) occupies two stories and includes a demonstration museum, a laboratory, drawing and record offices, photographic rooms, a library, and a mechanical workshop. There are also a number of smaller rooms designed for research students. It already contains a wealth of material for mosquito study not available elsewhere, and historical records of how the mosquito has been successfully combated on the island.

The formal opening, which took place on Monday, August 31, was presided over by Sir Richard Gregory, chairman of the Council of the new Institute. As a result of the preventive work undertaken, which has consisted largely of draining the inter-tidal areas, Hayling Island, which formerly was infested with "salt-marsh" mosquitoes, has now been practically cleared. In introducing the subject the chairman pointed out that in many parts of the world the question was whether the mosquito or man should survive. It was, he said, one of the glories of British science that much of its best work had been done by men who were not professional workers but had studied Nature simply because of the desire to gain knowledge, and without any ulterior motive. Mr. Marshall had been responsible for work of that kind, and the result of it was the building that was about to be opened, the British Mosquito Control Institute.

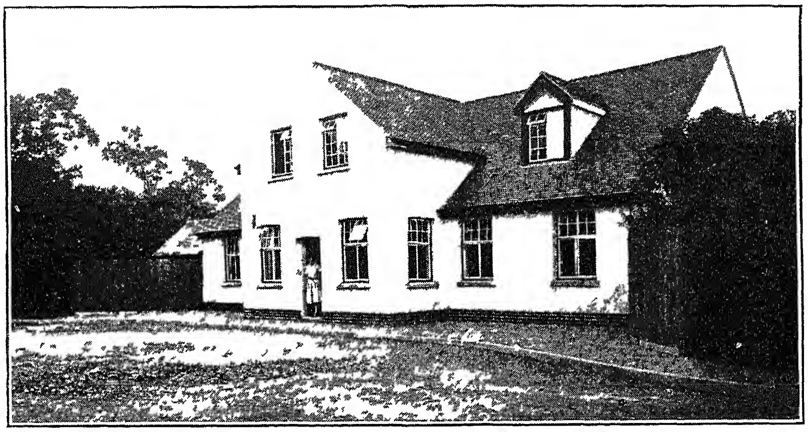

FIG. 1.—The British Mosquito Control Institute.

Sir Ronald Ross, in opening the Institute, described his own experiences at Hayling Island some three years ago. He had, he admitted, been sceptical as to the accusations made against *Ochlerotatus detritus*, the salt-water mosquito. Mr. Marshall, however, had convinced him by taking him to a part of his garden and inviting him to observe the insects flying about in broad daylight. In the course of his observations, Mr. Marshall had proved his point by directing his attention to the fact that three of the insects were simultaneously extracting blood from the back of his neck. Sir Ronald Ross pointed out that when he began work on the mosquito there was not a book or a good article dealing with the mosquitoes in India. Much is now known, but, in addition to knowledge, energy is necessary for acting upon it. What has been done in the Panama, at Ismailia, and in the Federated Malay States is only a beginning. He insisted on the importance of controlling not only the mosquitoes but also all those dangerous and unpleasant pests that prey on man and on his crops and herds. It is ridiculous that while man dominates the earth, the sea and the air, he should continue to be the prey of bacilli and even die from such contemptible things as colds in the head and mosquito bites. Improved medical and sanitary science and administration have, in the last eighty years, increased the average length of human life in Great Britain by about fifty per cent., yet men still die of many diseases which will one day be conquered. Sir Ronald Ross pleaded for the expenditure of a million pounds a year on medical research so as to accelerate the conquest of disease. Such a sum would be trivial compared with the money now spent on tobacco, alcohol, and entertainment, without taking into account what is spent on education, armaments and 'the dole.' While the work of the new Institute is to be general rather than medical, it will unquestionably keep the sanitary applications of mosquito control within range of its vision. The knowledge gained in the Institute will facilitate mosquito control in every region of the earth, and it is certain that the day will come when the fertile tracts now ravaged by king Malaria and king Mosquito will be laid open to civilisation. This happy result will, however, only be attained by more thought, by more research, and by a firmer determination to make the most of the beautiful world in which we live.

A vote of thanks to Mr. Marshall was proposed by Mr. C. Tate Regan and seconded by Col. James, of the Medical Department of the Ministry of Health. The Ministry, he said, greatly appreciates the good work done by Mr. Marshall. Col. James emphasised the importance of voluntary assistance given to the Government, and said that it is on this that the success of public health administration largely depends. He promised on behalf of the Ministry that it would watch the working of the Institute with great and, he hoped, helpful interest.

The ceremony concluded with a few words of thanks from Mr. Marshall, and it was announced that the composition of the Council of the Institute is as follows:—Major E. E. Austen, Dr. Andrew Balfour, Mr. F. Balfour-Browne, Sir James Crichton-Browne, Dr. H. Eltringham, Sir Richard Gregory, Col. S. P. James, Dr. G. A. K. Marshall, Prof. H. Maxwell Lefroy, Prof. E. B. Poulton, Sir Ronald Ross, Dr. Hugh Scott, Sir Arthur E. Shipley, Prof. Sir William Simpson, and Dr. C. M. Wenyon. The Trustees are Sir Richard Gregory and Mr. L. W. North Hickley, and the honorary director, Mr. J. F. Marshall.

Glutathione

THE isolation by Hopkins of glutathione, the dipeptide of cysteine and glutaminic acid, was a definite advance in our knowledge of the processes of oxidation and reduction in living cells. The compound was found to exist in two forms, the reduced and the oxidised; the latter consists of two molecules of the former united by means of the sulphur atoms of their cysteine portions after the loss of two atoms of hydrogen. The oxidised form thus acts as a "hydrogen-acceptor"; in the reoxidation of this reduced form it is probable that active oxygen is set free for oxidation processes in the cell, oxygen also acting as the "hydrogen-acceptor"; whether the compound was present in the oxidised or reduced form seemed to depend largely on the hydrogen-ion concentration. It was suggested by Quastel, Stewart and Tunnicliffe that the dipeptide was formed by the linkage of the amino group of cysteine to that carboxyl group of glutaminic acid which is furthest away from its amino group; they based their conclusion on a study of the breakdown of the molecule in various directions.

Stewart and Tunnicliffe have now confirmed this view by preparing glutathione synthetically and finding it identical with the natural product (*Biochem. Journ.*, 1925, vol. 19, p. 207). Two methods were employed: in the first, glutaminic acid was converted to hydantoinpropionic acid, and the latter then converted to the acid bromide with phosphorus tribromide and coupled with cystine dimethyl ester hydrochloride. The hydantoin ring was opened by boiling with calcium hydroxide, and the resulting compound, probably a uramino-acid, converted to the dipeptide by treatment with nitrous acid in slight excess of the amount necessary to remove one nitrogen atom. The dipeptide was isolated from the products of the reaction by means of the mercuric sulphate compound. The glutathione formed agreed with the natural product in all its properties except that its rotatory power was considerably less. This is probably due to racemisation during the formation and opening of the hydantoin ring. This result led the authors to their second method of synthesis: by acting directly on glutaminic acid with phosphorus tribromide, the acid bromide was formed in which the bromine replaced the hydroxyl group in the carboxyl furthest from the amino group. The acid bromide was coupled with cystine dimethyl ester and the glutathione isolated as in the previous method. The compound was found to be completely identical with the natural glutathione.

The amounts of the dipeptide occurring in tissues are very small; quantitative determination by actual isolation of the substance can only lead to approximate results owing to the losses which are bound to occur. Tunnicliffe has elaborated a method which is both quicker and probably more accurate (*Biochem. Journ.*, 1925, vol. 19, p. 194). The tissue is ground with sand and 10 per cent. trichloroacetic acid and filtered. The filtrate is titrated with $N/100$ iodine solution, the reduced form of glutathione being thereby oxidised. The end-point is judged by the use of sodium nitroprusside as an external indicator, with which the reduced glutathione forms a purplish colour. The method estimates the —SH groups in the extract: glutathione is the only known substance present which will give the reaction, since there is no evidence that cysteine exists in the free state in the tissues normally. Most of the glutathione appears to be present as the reduced form in the cells. Skeletal muscle of the rat or rabbit contains about 0.03 to 0.04 per cent., and liver 0.2 to 0.25 per cent.; yeast contains about the same percentage as liver; it is completely absent from blood. The values obtained thus are three to five times greater than the amounts actually isolated.

The product obtained from tissues has been found to contain small quantities of iron. Harrison has determined its amount and obtained a value of 0.6 per cent. (*Biochem. Journ.*, 1924, vol. 18, p. 1009). Now the reduced form of glutathione undergoes spontaneous oxidation in air; recognising that iron frequently acts as a catalyst in oxidations, Harrison prepared a pure glutathione and examined its rate of oxidation in air. The uptake of oxygen was much slower than in the case of the impure preparation: the author considers that this may be due to traces of catalysts which have escaped removal. As with the impure compound, cyanides inhibit this uptake of oxygen, probably by forming a compound with the iron.

The oxygen uptake in these cases, including that of pure glutathione, is a linear function of the time over a large part of the course of the reaction: this is probably due to the fact that the rate of oxidation depends on the amount of dissociated ionised iron present; the sulphydryl group can lose its hydrogen more quickly than oxygen can be prepared to receive it. Increasing amounts of cyanide decrease the rate of oxidation by decreasing the amount of ionised iron present. On the other hand, when relatively large quantities of iron are available the rate of oxygen uptake decreases continuously, since excess of active oxygen is present throughout and the amount of the sulphydryl compound becomes the limiting factor and its concentration progressively decreases with its oxidation.

The inhibiting effect of cyanide is less marked in the presence of organic iron, for example hæmatin, and in correspondence with this, Harrison has found that cyanide has a less marked effect in reducing the oxygen uptake of glutathione in the presence of a thermostable preparation of muscle tissue, which has the power of reducing the oxidised form of glutathione to the sulphydryl compound.

Further light has been thrown on the mechanism of the action of glutathione in the oxidation processes of tissues by some recent experiments by Tunnicliffe (*Biochem. Journ.*, 1925, vol. 19, p. 199). The reduction of the oxidised form by the tissue preparation in the absence of oxygen is rapid for the first three hours and complete in about five hours: only a certain quantity can be reduced by any given tissue preparation, this amount being the measure of the labile hydrogen of the tissue. The same tissue will reduce a similar quantity of methylene blue. The nature of the buffer salts and the reaction of the medium have no influence on this reduction. On the other hand, the reverse change, the oxidation of reduced glutathione, proceeds more rapidly in a slightly alkaline medium than in an acid medium. In the presence of oxygen, the tissue will reduce the glutathione, which will forthwith become oxidised again and the process will only cease with exhaustion of the labile hydrogen of the tissue or of the oxygen supply.

If, however, the amount of oxygen actually taken up is measured, it will be found to exceed considerably that necessary to oxidise the reduced glutathione formed by the tissue: the excess is considerably greater in the absence of phosphate ions. Hence concurrently with the oxidation of the glutathione, oxidation of some other substance must be taking place, and Tunnicliffe considers it probable that this is of the

nature of an unsaturated fatty acid since Meyerhof has shown that the oxidation of linolenic acid is accelerated by the simultaneous oxidation of a sulphydryl group present at the same time Thus the oxidation of the fatty acid depends on the presence of the reduced glutathione, which in turn is formed by the hydrogen donators ' of the tissues When oxygen acts as a hydrogen-acceptor removing the hydrogen from the reduced glutathione which is thereby oxidised part of the oxygen becomes activated and available for the oxidation of other substances present in the cell

The Royal Observatory, Edinburgh, and Accurate Measurements of Time

THE record of the work done in 1924 at the Royal Observatory Edinburgh recorded in the annual report of the Astronomer Royal for Scotland, Prof R A Sampson, is of supreme importance to those interested in the accurate measurement of time

For some years Edinburgh has taken the lead in this subject and Prof Sampson's papers before the Royal Society of Edinburgh and the Royal Astronomical Society on the performance of his clocks have been followed with keen interest in the observatories of the world His three first-grade clocks are the Riefler No 258 which, we understand, is one of the best turned out by the famous Munich firm Leroy No 1230, which is a duplicate of those at the Paris Observatory used in connexion with the time transmission from the Eiffel Tower and Shortt No 0, the original Free Pendulum of the Synchronome Co

By means of an oscillograph and micro-chronograph which resembles a cinematograph camera Prof Sampson s clocks are in effect *put under a microscope*, that is to say, their performance is observed and automatically recorded each day to an accuracy of one thousandth part of a second, a method which Prof Sampson says " rarely fails to show when one or other of them has changed rate by as much as 01 sec " The daily comparison he continues demonstrated a decided superiority in the rate of clock Shortt, indeed the other two were scarcely able to serve as a check upon it Therefore with the view of carrying time work to the limit that the appliances will allow a second model of the clock (Shortt No 4) was installed in January in one of the vacant clock cells in the basement The connexions for temperature control are the same as in the other cells The original clock of these series (Shortt No 0) which was erected here for trial by Mr Shortt in 1923, and has shown such remarkable going has been generously presented to the Observatory by the Synchronome Company Limited, in association with whom Mr Shortt had prepared his model Briefly, it may be said the only discernible faults in the going of Shortt No 0 are a small temperature coefficient showing when an accident disturbs the temperature control of the cell and a minute leak in the case, which has not been located

Prof Sampson's investigations in recent years have focussed attention upon the lack of precision in transit observations, upon which of course all time determinations are based Instrumental errors in the transit circle telescope have always been carefully measured and allowed for They take a prominent part in the somewhat complex process of smoothing the clock rates In the race for accuracy the precision of the clock and of the means of comparison by wireless time signals have outrun the precision of transit observations

Radio telegraphy has enabled distant observatories to compare their times with great precision thanks to the rhythmic signals or " time-vernier " and they are found to disagree by amounts which though they may appear trivial to a layman are of considerable importance in an exact science such as astronomy Astronomers have indeed been considerably perturbed at their lack of agreement, and Prof Sampson had set himself the task of searching for the cause of the error which has been found to occur in time determinations at all observatories

Prof Sampson now makes the definite statement that " owing to improvements in the clock and chronograph system in this Observatory, and in receiving apparatus for W T signals from other observatories it has proved possible to bring this investigation to an issue It has been found that during the whole of 1924 the whole of the large erratic or systematic errors are removed if the level error determined as usual by the mercury bath is rejected, and the observations reduced instead by an azimuth error derived from one of the collimators, in combination with the usual observations of polar stars The implications of this result are of high interest and importance to astronomers and will be pursued '

Referring later to his automatic records of the numerous W T signals Prof Sampson says ' the comparison of time determined at this observatory with the same determined elsewhere exhibits features of the sub-systematic character that had been noted in previous years, though each observatory had cleared its determinations of all known errors As remarked above, the source of these discrepancies appears now to be located, at least so far as the observatory is concerned "

F H -J

World Meteorology and Long-range Forecasting [1]

THE possibility of seasonal forecasts in India was first investigated by H F Blanford about 1876, using only the snowfall in the Himalayas As the research proceeded, it was found necessary to consider conditions farther and farther away, until in the hands of Sir Gilbert Walker it developed into an investigation of the inter-relationships of weather in all parts of the world A chart of the average barometric pressure over the globe shows a number of more or less permanent areas of high and low pressure, for example, the Azores high and the Icelandic low In these areas the variability of pressure reaches a maximum and they are accordingly termed " centres of action ", the pressure changes of intervening places, such as the British Isles, are dominated by those at the centres of action

Sir Gilbert Walker has realised that these " strategic points " offered the best chances for an attack on the problem of long-range weather forecasting and has studied in great detail the relations between twenty different centres of action In " Correlation in Seasonal Variations of Weather," Part 8 (Memoirs of the Indian Meteorological Department), published in 1923 he laid down the groundwork of a theory of world weather and outlined the mechanism by which variations in one part of the world are transmitted to other parts of the world a few months later The

[1] A Further Study of World Weather Applications to Seasonal Forecasting in India By Sir G T Walker (Memoirs of the Indian Meteorological Department, vol 24 Parts 9 and 10)

problem is, however too complex for a sufficiently complete theoretical solution to be possible at present, and the only method is the patient comparison of the pressure variations in each centre of action with the subsequent variations in all twenty centres This laborious research has been carried out, and the results are presented in Part 9, "A Further Study of World Weather ' The quarterly means are compared with those for two quarters before, one quarter before, the same quarter and one and two quarters after, at all stations—some 4000 correlation coefficients in all From these coefficients 189 relationships are found which are probably significant according to the author's rigid standard, and are of value for seasonal forecasts either six months or three months ahead

The consistency of the relationships is very remarkable, and "supports the view that seasonal forecasting is capable of wider application than at present' Most of the significant relationships discovered are between the different tropical and sub-tropical centres, at which weather abnormalities usually persist for several months, and the research indicates possibilities for the initiation or improvement of seasonal forecasting in such regions For countries within the temperate storm belts, such as the British Isles the outlook is not so hopeful, the significant correlation coefficients are fewer and smaller, and the fluctuations from month to month are often so great that the value of a general three-monthly forecast is limited The final solution of the problem of long-range forecasting in temperate latitudes will undoubtedly have to take account of world-relationships but only as giving a general tendency to the weather, the fluctuations of shorter period being determined by other and more local causes

In Part 10 Sir Gilbert Walker returns to the original purpose of these studies and gives an example of the application of the results to seasonal forecasting in India From the closest relationships found between rainfall in India and the preceding conditions in other parts of the world, greatly improved formulæ are deduced for forecasting the monsoon rainfall of different districts and the winter precipitation of the Himalayan region The formulæ impress one very strongly with the meteorological unity of the world, that for Peninsula rain, for example, depending on the preceding conditions in such widely scattered regions as Alaska, South America, and Rhodesia The statistical basis is sufficiently complete for the forecasts to be made confidently, and while in the story of Indian forecasting, begun fifty years ago, the final chapter is not yet written, we may reasonably believe that the main lines of the plot have been laid bare

University and Educational Intelligence

IN the course of an address delivered on September 4 at the opening of a new secondary school at Preston Lodge, East Lothian, Lord Balfour made some noteworthy remarks on the relation of schools to universities and on the importance of research in pure science If the university is compelled to act the part either of the primary or secondary school its work is hampered its utility diminished, and its wheels clogged The purpose of the secondary school is, however, not merely to prepare students for the university, but rather to give an education by means of which those who are unable to go to the university can face life without feeling seriously handicapped Referring to the importance of the practical teaching of science, Lord Balfour said he was glad to learn that science is to form a prominent part of the curriculum of the new school, and that it is to be taught by laboratory demonstration and experiments "Industry in the future," he said, "must be based upon science" If industrialists imagine that science can be built up without a disinterested love of knowledge, they fall "into the most grievous blunder" The multiplication of subjects in modern secondary and university education and the specialisation it entails are regarded by some as disastrous to the progress of education and the highest interests of culture and learning Lord Balfour stated that, if the dangers of specialisation are kept in view, they can be reduced to a minimum and the necessary flexibility, variety, and complexity of modern education successfully maintained

THE Geographical Association has been experimenting for some time in the matter of conducted educational tours for teachers under the direction of volunteer experts Some teachers and members of several universities joined a group of honours students in geography, of the University College of Wales, Aberystwyth, at Easter in a tour around France, under the direction of Miss S Harris of the staff of that College At the beginning of August, two groups left England to study the Alps, one the western Alps, starting from Chamonix and one the eastern Alps, starting from Innsbruck They were under the leadership, respectively of Mr J I Platt and Miss S Harris both of the University College of Wales Aberystwyth Among their objects was the demonstration of the newer views of earth history, and especially of mountain building, to which MM Argand and Staub have given expression in the last few years The charabanc has made it possible for teachers to intensify their knowledge of Britain and tours have been organised to various natural regions of England, and to North and Central Wales, to demonstrate structural and general physical features with particular reference to the ways in which these factors have affected settlement, industries and communications These tours were organised under the leadership of Messrs E E Lupton and V C Spary The Tours Committee of the Geographical Association would like to experiment further by specialising on selected regions for more intensive study if a sufficient number of members and intending members care to take part All communications concerning tours should be sent to the honorary secretary of the Tours Committee, Mr E E Lupton, 73 Bierley Lane, Bradford

THE Institute of Intellectual Co-operation, of which the governing body is the League of Nations Committee on Intellectual Co-operation, presided over by a French member of the Committee, is expected to open its doors towards the end of the year The directorate of the Institute is composed of the following members M Bergson, M de Reynold, Prof Lorentz Prof Gilbert Murray, and Senator Ruffini The Director is M Julien Luchaire Inspector-General of Education in France The budget for 1926 amounts to 2 100,000 French francs two millions of which represent the grant made by the French Government and 100 000 that of the Polish Government The Committee at its meeting of July 27-30 approved of the adoption of an international students' card as recommended by the International Students' Federation It took note of a memo by Dr Hagberg Wright, Director of the London Library on the subject of the international borrowing of books, and recommended a series of practical measures for facilitating such loans It considered also questions relating to intellectual property, an international meteorological bureau, an international university for the training of statesmen, journalists and others, the unification of scientific nomenclature, and a loan for the development of intellectual life

Early Science at Oxford

September 16, 1684 Dr Plot began reading his discourse *de Origine Fontium* half of which being read, we proceeded to other matters

A letter from Dr Pit was read, which promises his discourse concerning Digestion, and gives an account of a woman, who, by reason of stoppages for three monthes, complained of a load, and fullness of her stomach vomited blood, flesh, and blood-vessells, as big as goose quills, after which, by ye help of some Physick, she recovered

A Letter from Mr Molyneux, dated Dublin September ye 2nd 1684, was read It gave an account, that Mr Osburn had observed ye last solar Eclipse near Tredagh in Ireland, lat 53° 40′ Initium H 1 37′ 30″ finis H 3 56′ 20″

Merchant Wayt's account of his peice of Incombustible Cloth was read

A Letter, written at ye Request of this Society, by Mr President, to be sent to ye head of each of the Universities in Scotland, for the establishing a Correspondence in that Kingdom was read

Sir Robert Sibbald's *Scotia Illustrata*, was presented ye Society

Dr Mark an ingenious Brandenburg Gentleman, was proposed, in order to be elected a member of this Society

September 23, 1684 Dr Plot continued ye reading of his discourse *de Origine Fontium*, and severall other things were offered to ye Society, but ye company being very small, they were referred to another meeting

September 30, 1684 Dr Plot made an end of reading his Discourse *de Origine Fontium*, after which, ye Society gave him their thankes, for communicating to them so succinct an account, of what has been delivered by other writers, and of his own observations on this subject and also made it their request, that he would be pleased to print ye same

A letter from Mr Aston, dated September ye 25th, was read in it were contained some observations of ye late solar Eclipse taken by severall French astronomers and printed in ye *Journall des scavans* They are translated into English, and will suddenly be printed in ye Transactions

Part of a Letter from Dr Cole of Worcester, dated September ye 27th, was read which informed the Society, how very ready that learned physitian is to correspond with us and to comunicate to us, whatsoever shall occurr to him fit to be imparted

Dr Plot comunicated an old silver ring lately found in Staffordshire, with this motto, *in Godt al*, and an old Roman brass ring gilt about two ounces, 3 drams in weight, sent him by Mr Packer, Physitian at Reading this ring had a cornelian set in it, and four collets round ye cornelian, for as many stones more, three of which were lost

A large stone consisting of severall Branches, taken out of ye kidney of a woman by Mr Packer, was communicated by Mr Welstead An Account of this Stone will be printed in a little time

Spongia arborescens erythminiformis, i e of ye forme of Samphire, from Devonshire, and some of the button berries, from Jamaica, as also some Kelp, embroydered with ye shells of fish growing on ye leaves of that plant, (all which are a part of that present the generous Mr Cole of Bristoll lately made this University) were communicated to us by Dr Plot

Dr Caspar Marck haveing been proposed, Sept 16th, his admission was now put to the Ballot, and carried in ye affirmative, after which he subscribed to the Articles

Societies and Academies

London

Institute of Metals (Autumn Meeting, Glasgow), September 3 —Robert J **Anderson** and Everett G **Fahlman** The effect of low-temperature heating on the release of internal stress in brass tubes The work was carried out to determine a suitable heat-treatment which would prevent warping of manufactures made of lead-brass tubing on standing for a period at the ordinary temperature, and at the same time effect stress release without material loss in hardness and strength Heating for 2 or 3 hours at 325° C or for 4 hours at 300° C in the case of material reduced 22 4 per cent in area is satisfactory, but the mill control of separate lots of tubing must be substantially identical if a given heat-treatment procedure is to be applied to the material —L H **Callendar** Passification and scale resistance in relation to the corrosion of aluminium alloys Aluminium is a passive metal, its normal reactions are modified by the presence of a hydroxide scale of high mechanical, chemical, and electrical resistance Corrosion in water may be started by solution or peptisation of this scale, it may be stopped by precipitation of scale on the metal surface Chlorides reduce the resistance and adherence of these scales, and carbonates tend to increase scale resistance Nitrates passify the metal by direct oxidation and anodic polarisation Dichromates combine the passifying action of nitrates with the formation of a highly resistant scale containing chromate —O W **Ellis** The influence of pouring temperature and mould temperature on the properties of a lead-base antifriction alloy Within the limits of the experiments, the replacement of lead by antimony increases the resistance to compression and increases the hardness The replacement of tin by copper increases the resistance to compression but scarcely affects the hardness Mould temperatures are more important than pouring temperatures There is evidence of an intermetallic reaction in the copper-bearing alloy in the liquid state at 334° C —R H **Greaves** and J A **Jones** The effect of temperature on the behaviour of metals and alloys in the notched-bar impact test Copper, aluminium, and lead showed a continuous fall in impact figure from − 80° C to the melting-point Maxima in the impact figure-temperature curves were shown by tin at 0°, zinc at 150°, duralumin at 400°, lead-free 70 30 brass at 800°, 60 40 brass at 715°, 10 per cent aluminium bronze at about 750° C On the other hand, 70 30 brass containing 0 02 per cent or more of lead, and coinage bronze, showed no similar improvement in impact figure at high temperatures A high notched-bar impact figure seems to indicate good rolling properties, for many alloys there is a range of temperature within which their behaviour on rolling is likely to be worse than at either higher or lower temperatures —D **Hanson** and Marie L V **Gayler** On the constitution of alloys of aluminium, copper, and zinc —Harry **Hyman** The properties of some aluminium alloys Aluminium alloys available for sand castings for engineering purposes generally possess low ductility, and this renders them difficult to manipulate in workshop practice, also they are readily susceptible to corrosion A series of alloys was prepared with the view of passing a minimum test of 5 tons yield point, 10 tons breaking stress, and 5 per cent elongation on sand-cast test-bars, and at the same time capable of undergoing a severe salt spray corrosion test without marked loss in weight The alloy B S 7, containing copper, nickel, iron, and magnesium, gave the most promising results, and has

been adopted on a commercial scale —Douglas H **Ingall** The high temperature-tensile curve (*a*) Effect of rate of heating, (*b*) Tensile curves of some brasses For any given load the breaking temperature and the critical inflection temperature are lower the slower the rate of heating In the lower temperature, straight-line portion of the curve, the relationship between breaking temperature and rate of heating may follow a hyperbolic curve, which would establish a definite fundamental tensile strength for any given temperature Alloying increases the number of loops in the higher temperature curve over a given range of temperature this is probably due to space lattice distortion The high temperature-tensile curves of the brasses indicate that the solution of zinc in copper, over the α-range of composition, is not simple —George B **Phillips** The primitive copper industry of America There was a pre-historic copper industry in America, carried on by aborigines, who made widespread use of copper for tools, weapons implements, ornaments, and ceremonial objects This extensive manufacture of copper implements of similar shape to take the place of the stone and bone articles formerly used seems to justify the claim of a primitive copper culture for the American Indians, suddenly interrupted by the arrival of the Spaniards —D **Stockdale** The α-phase boundary in the copper-tin system Specimens were brought into equilibrium by quenching from a high temperature followed by long heat treatments at the supposed temperatures of the transformations At ordinary temperatures the solubility of tin in copper is much higher than any previous diagram indicates, it is 16 0 per cent of tin by weight This result does not affect bronze-bearing metals, because such material when originally cast consists of the α and δ phases, and the hard δ shows no tendency to dissolve in the soft α at low temperatures The existence of a transformation in the β phase has been confirmed

PARIS

Academy of Sciences, July 27 —Henri **Jumelle** The tombak tobacco of the Alaonites —Alexandre **Rajchman** Multiple convergence —Th **Vautier** Secondary waves due to an aerial wave —Nobuo **Yamada** The long-range particles emitted by the active deposit from radium —Andre **Graire** The theoretical and practical conditions of reversibility of the reactions in the leaden chamber process —Munenari **Tanaka** The quinonediazides of the anthraquinone series —G **Vavon** and P **Peignier** The preparation of active isoborneol Two methods have been worked out and are described in detail, one starting with pinene hydrochloride, the other by the catalytic hydrogenation of camphor —E **Rothe** The earthquake of February 22, 1924 in the Pyrenees Discussion on the epicentre — — **Gabriel** The application to meteorology of the astronomical cycle of 744 years —Mlle G **Bonne** The retrogression bundles in the floral section of certain Rosaceæ —Ad Davy de **Virville** The effect of hygrometric state and of submersion on the form and structure of mosses —Antonin **Němec** and Mihovil **Gračanin** The influence of the reaction of the soil on the absorption of phosphorus and potassium in the presence of various phosphatic manures —R **Hovasse** The Ellobiopsidæ propagated by flagellispores —J **Dumas** G **Ramon**, and Said **Bilal** The immunising properties of dysenteric anatoxin

SYDNEY

Linnean Society of New South Wales, June 24 —J R **Eyer** and A J **Turner** The Australian species of Oncopera (Hepialidæ, Lepidoptera) A key to the species is given, based on the characters of the male genitalia, as well as a key to the superficial characters Two species are described as new, making four species in all in the genus —A B **Walkom** Fossil plants from the Narrabeen stage of the Hawkesbury Series Near the base of the stage, a few species have been found representing a survival of the Glossopteris flora Higher up the flora is quite distinct from the Glossopteris flora, and about twenty species are known No description of this flora has been published hitherto —A Eland **Shaw** New genera and species (mostly Australasian) of Blattidæ, with notes, and some remarks on Tepper's types Notes are given on many of Tepper's types in the South Australian Museum Four genera and twenty-five species are described as new, and an attempt has been made to explain some of the peculiarities of structure in the Panesthiinæ most strongly evidenced in the earth-digging group

Official Publications Received

Proceedings of the American Academy of Arts and Sciences Vol 60, No 2 New Researches on the Magnetization of Ferromagnetic Substances by Rotation and the Nature of the Elementary Magnet By S J Barnett and L J H Barnett Pp 125 216 (Boston Mass) 1 50 dollars

Bulletin of the Geological Institution of the University of Upsala Edited by Hj Sjogren Vol 17 Pp vi+450+11 plates Vol 19 Pp iii+249+8 plates (Upsala Almquist and Wiksells Boktryckeri A B)

University of Colorado Bulletin Vol 25 No 6, General Series No 219 Catalogue, 1924–1925 with Announcements for 1925–1926 Pp 394 (Boulder, Colo)

Imperial Economic Committee Report of the Imperial Economic Committee on Marketing and Preparing for Market of Foodstuffs produced in the Overseas Parts of the Empire First Report General (Cmd 2493) Pp 38 (London H M Stationery Office) 9*d* net

Lawes Agricultural Trust Rothamsted Experimental Station, Harpenden Report 1923-24, with the Supplement to the "Guide to the Experimental Plots containing the Yields per Acre, etc Pp 130 (Harpenden, Herts) 2*s* 6*d*

Anatomical Society of Great Britain and Ireland Proceedings May 1921–February 1925 Recorded by P J Gladstone, edited by E Barclay Smith Pp 120 (London Cambridge University Press) 12*s* 6*d* net

Bulletin of the National Research Council Vol 9, Part 3, No 50 Bibliography of Bibliographies on Chemistry and Chemical Technology, 1900–1924 Compiled by Clarence J West and D D Berolzheimer (Washington D C National Academy of Sciences)

National Association of Master Bakers Confectioners and Caterers Report on Research at the National Bakery School, London By Dr C Dorée and J Kirkland Pp 27+10 plates (London Regent House, Kingsway) 2*s* 6*d*

Indian Forest Records (Economy Series) Vol 11 Part 9 Summary of Investigations on Bamboos and Grasses for Paper Pulp By W Raitt Pp ii+11+1 plate (Calcutta Government of India Central Publication Branch) 8 annas 9*d*

Imperial Economic Committee Report of the Imperial Economic Committee on Marketing and Preparing for Market of Foodstuffs produced in the Overseas Parts of the Empire Second Report Meat (Cmd 2449) Pp 35 (London H M Stationery Office) 9*d* net

Scientific Papers of the Institute of Physical and Chemical Research, Tokyo Vol 3, No 32 On the Physical and Chemical Properties of Biosterin (a Name given to Fat Soluble A) and on its Physiological Significance By K Takahashi, Z Nakamiya, K Kawakami and T Kitasato Pp 81 146 Vol 3, No 33 Condensation of Nitriles with Thiamides, V Action of Sulphur Monochloride upon Thiamides By S Ishikawa Pp 147-154 Vol 3 No 34 On the Behaviour of some Spark Lines of Carbon in an Electric Field By S Nakamura and Y Fujioka Pp 155 162 Vol 3, Nos 35 36 A new Discussion of Bucherer's Experiment, On the Interpretation of the Results of Bucherer's Experiment By U Doi Pp 163 182 (Tokyo)

Union of South Africa Department of Mines and Industries Geological Survey Cape Sheet No 5 Laingsburg The Geology of the Country near Laingsburg Explanation to Cape Sheet No 5 By Dr A W Rogers Pp 34 (Pretoria Government Printing and Stationery Office) 2*s* 6*d* net

Report of the Aeronautical Research Committee for the Year 1924–25 Pp 44 (London H M Stationery Office) 1*s* 6*d* net

Aeronautical Research Committee Reports and Memoranda No 956 (Ae 174) The Airflow round a Body as affecting Airscrew Performance By C N H Lock H Bateman and H C H Townsend Pp 22 1*s* 3*d* net Reports and Memoranda No 969 (Ae 185) A Note on the Katzmayr Effect That is The Effect on the Characteristics of an Aerofoil produced by an Oscillating Airstream By W L Cowley Pp 5 6*d* net (London H M Stationery Office)

University of Bristol The Annual Report of the Agricultural and Horticultural Research Station (The National Fruit and Cider Institute), Long Ashton, Bristol 1924 Pp 135 (Bristol)

Department of Industries Madras Report for the Year ended 31 March 1924 Pp iv+89 (Madras Government Press) 6 annas

Imperial Department of Agriculture for the West Indies Report on the Agricultural Department, St Kitts Nevis, 1923–24 Pp iv+39 (Barbados) 6*d*

SATURDAY, SEPTEMBER 19, 1925

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Editorial and Publishing Offices
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The Future of the British Patent Office

IN the issue of NATURE for February 7 of the present year, we dwelt at some length upon the qualifications which were called for in the head of the British Patent Office, and concluded that the responsibilities of the Office were such that the staff should be presided over by a man eminent in science. The interest which our remarks aroused, combined with the passing of time when a new official in the ordinary course of events will be appointed, lead us again to refer to the same subject and to emphasise the importance of the position occupied by a Comptroller-General of Patents and the desirability for the post to be allotted to one in whom discoverers, inventors, scientific workers, manufacturers, and lawyers would have confidence.

As we have already pointed out in our former article, the duties of a Comptroller are multifarious. Apart from those in which science, industry, and law occupy so great a part, there are many duties referable to clerical management which, very properly, may be assigned to a subordinate. With these duties, however, we are not here concerned. We desire rather to consider some special aspects which we trust will be present in the minds of those who in due course will be called upon to select the individual best fitted to perform the functions inherent in one of the important offices in the State.

Under the Patent Law Amendment Act of 1852, down to January 1884, the granting of patents was in the hands of the Commissioners of Patents, among whom were the Lord Chancellor and the Master of the Rolls. During that period, therefore, the department was almost entirely of a legal character and only remotely associated with the manufacturing classes. When the Patents Act of 1884 came into operation—now superseded by other Acts—the Patent Office was created and its functions transferred to the Board of Trade, in the control of which the Office has continued to the present day. At the same time, in 1884, a body of examiners was created, composed of persons who, by their training, were qualified in the various branches of industry and science in which they had had experience. By a further section of the Patents Act a Comptroller-General was appointed head of the Patent Office.

Since January 1884 three Comptrollers have successively held office. Without in any way attempting to depreciate the great abilities which have been shown by these Comptrollers in their respective spheres, we may say that none has held high position at the Bar, or has been in close touch with the manufacturing interests of the community, or has been distinguished in scientific circles. Each appears to have been content to be strictly "official." Some may perhaps see in this the truly distinctive British policy of "muddling

through," a policy which, however successful in the past, is not necessarily bound to serve in the future But a policy such as this is by no means compulsory, on the want of a suitable candidate being known, there would be found many whose qualifications are of the highest who would be willing to undertake the responsibilities of the post, provided the remuneration offered was commensurate with the duties to be assumed and approached the salary obtainable outside the Civil Service

It is only fair to remark, however, that the policy since 1883 has resulted in some substantial gain, and that a definite amount of progress has been secured Thus mention has been made in previous articles of the setting up of a system of a limited search for "novelty" and a publication of abstracts of all specifications Minor alterations in the law have also brought about the changes which the public has demanded, while the payment of fees, many of which are on a low scale, has been facilitated But, speaking generally, the Board of Trade has been content to follow some distance behind public opinion and has resisted changes until agreement had been arrived at on all sides One is almost tempted to say that the pouring into the national revenue of profits from the Patent Office of annual sums exceeding 70,000*l* has had a soporific effect upon the Board of Trade, with the result that stagnation rather than progress has resulted Now, within a measurable distance of time, the Board will have to appoint a new chief of the Patent Office, and thereby to settle for a considerable period the silent but certain trend of affairs in a department where the interests of all classes of the community meet on a common level

The same problem which is involved in the selection of the chief of the Patent Office has also presented itself to the Government of the United States of America It would be well, therefore, to consider for a moment the way in which that problem has there been attacked In the United States, as in Britain, administration of the Patent Office involves mixed questions of law, science, and technics, and it appears to be the present policy of the U S Office, in the first place, not to promote any examiner to the position of Primary Examiner unless he has studied law and become a member of the Bar, it being premised that an examiner before entering the Office has passed a severe examination in science and industry The Commissioner of Patents is chosen from among the patent lawyers or, in some instances, by the promotion of Assistant Commissioners of Patents who have risen through all the grades in the Office It is, however, generally understood that neither the Patent Bar nor the industrial interests would tolerate the appointment of a Commissioner who had had neither a scientific education nor extensive experience as a patent lawyer Custom and public sentiment in the United States demand that a Commissioner of Patents shall have had large experience in the practice of patent law and either a scientific education or extensive dealing with scientific questions

Powerful advocacy for a thoroughly efficient Patent Office is to be found in the speech of the Prime Minister when reviewing the nation's position in the debate upon the unemployment question in June last Mr Stanley Baldwin said on that occasion that—

"No one will assert that British Industry can be saved by science alone, but it is none the less true that until scientific methods and scientific men can take their place in industry, and an equal place with the administrator and the financier, British trade will never be strong enough or resilient enough to meet the shocks that it is bound to meet as the years go by, to meet the sudden and unexpected changes which will always arise in international trade"

As the *Times* commentator expressed it "Mr Baldwin, as a business man himself, knows that there are thousands of people among us who already work up to the limit of their capacity and their strength But he thinks that many employers by using their brains could add another ten per cent to the efficiency of their several industries, and he touched briefly on some of the lines on which our conservative methods and practice might be improved"

It is an aim of the patent system to stimulate and assist employers in securing this increase of ten per cent efficiency The head of the Patent Office, with the qualifications which we have expressed, might be expected to make his influence felt not only within the narrow limits of his department but also in other regions far removed from bureaucratic control The cry throughout the country is for increased production To the discoverer and inventor we must look for a cutting adrift from old contrivances and for the best means and the most expeditious ways of bringing into being those necessities upon which our welfare as individuals and as a nation so much depends Stimulation to industry and to invention is demanded if the position which the country held in the nineteenth century is to be recovered A Comptroller-General high in scientific, engineering, and other technological societies, in touch with industrial concerns, and acquainted with the special needs of the various classes of persons to whom the industrial use of inventions is of paramount importance, would know best how to make the Patent Office play an effective part in the furtherance of the general advance

We have set out in some detail the main qualifications which we think are desirable in a Comptroller of the Patent Office That there are many in whom these qualifications may be found we have no doubt There

are some even in the Civil Service who, not having surrendered themselves to the cramping conditions of their environment, could adequately fill the post. It is fairly certain, however, that a greater choice lies to hand outside the ranks of the Service; for, in general, it is more probable that the ideal man has already come to the front in situations where foresight, intelligence, and business capacity, unfettered by artificial restriction and official timidity, have been essential to success.

When such a man has been discovered, we may consider for the moment how his services are to be obtained. What are the inducements for him to leave his present position and to submit to the ruling of the permanent officials under whom the Patent Office is administered? At the end of a quiet and successful domestic career in the Civil Service there awaits the holder of an important position the companionage of an illustrious order with a possible knighthood. In extreme instances a Civil Servant becomes ennobled. In these respects, however, service under the Crown does not differ materially, or for the better, from commercial service. What then are the pecuniary advantages? Apart from security of tenure of office, which of course is a valuable asset, the salary attaching to the Comptrollership is altogether inadequate to attract the class of man who is so eminently desirable. The salary of the Comptroller of Patents is 1500*l.* per annum. To this there must be added a bonus calculated according to the published scale, say a sum of 200*l.*, which makes 1700*l.* in all. It may be said frankly and once for all that for such a sum the man who has given proofs of his ability in other walks of life to conduct the business of the Patent Office upon fitting lines is not to be found. The sum must be increased if the proper man is to be attracted to the post.

The Board of Trade, in conjunction with the Treasury, have the matter in their hands, for it is extremely unlikely that Parliament, which has the final control of salaries, would reject an increase which is shown to be necessary for securing the services of the right man. This selection is not merely a domestic matter which alone concerns officials in the Civil Service; it is one that affects industrialists, whether employers or employed. The issues are serious. Are we content to jog along as of old, making a minimum of progress even if stagnation is not present? Or are we to see assistance rendered in every department of industry, assistance in bringing forward the backward inventor, assistance towards the perfecting of the inventors' schemes and the securing of their best practical forms for immediate use by the public? It is therefore for the Board of Trade at the proper time to show that it is alive to the potentialities that await its selection of the head of the Patent Office.

The World's Scientific Periodicals

A World List of Scientific Periodicals Published in the Years 1900–1921. Pp. xii+499. (London: Oxford University Press, 1925.) Two volumes, 3*l.* 10*s.* net (in cloth) or 3*l.* 3*s.* net (in paper).

THE "World List of Scientific Periodicals" had its origin in a letter written in 1920 by Sir Sidney F. Harmer, Director of the Natural History Departments of the British Museum, to Dr. P. Chalmers Mitchell. Sir Sidney Harmer asked that the Conjoint Board of Scientific Societies might consider the possibility of preparing a list of the chief scientific periodicals with an indication of the libraries in which these might be consulted. Dr. Chalmers Mitchell at once declared himself a warm advocate of the idea. Indeed, as secretary of the Zoological Society, and an enthusiastic supporter of the "Zoological Record," he had already taken some steps toward the inclusion in the "Record" of some indication of the libraries where the periodicals indexed could be found. Before the War, the Council of the Zoological Society had granted a small sum of money to compile a list of periodicals containing zoological articles, with indication of the libraries in London which had these periodicals on their shelves. This compilation had not been completed when war broke out.

The effort then made showed that the task of drawing up a list to show where each periodical could be consulted was a formidable one. While some periodicals are taken by several libraries, others are only to be found in one or two libraries, and many are not taken by any library in Great Britain. Even when a periodical is subscribed for, it is sometimes found that the series on the shelves is incomplete.

The Executive Committee of the Conjoint Board of Scientific Societies at once adopted Sir Sidney Harmer's suggestion in principle, provided that it should cover all branches of science. A Committee was appointed consisting of Sir Sidney Harmer, Mr. F. W. Clifford, Sir Richard Gregory, Dr. P. Chalmers Mitchell, Dr. A. W. Pollard, and Prof. W. W. Watts. The Committee decided that scientific periodicals in existence from January 1, 1900, should form the list, that the libraries to be indicated as taking in these periodicals should be those in London, Oxford, Cambridge, Edinburgh, Dublin, and Aberystwyth, and that, whenever possible, at least one library in the United Kingdom should be indicated for each title.

The objects of the list were declared to be:

(1) To supply a list of current scientific periodicals as nearly as possible complete.

(2) To indicate, where possible, at least one library where each periodical is taken.

(3) To form a basis for co-operation between libraries, so that both the number of duplicates and the list of periodicals not taken in at any centre may be reduced.

(4) To enable any library to use the list for its own purposes, by placing a mark against the title of each periodical it possesses, or by cutting up the pages to prepare a Card Catalogue. The list is accordingly printed only on one side of the paper, so as to make cutting up practical or to afford space for additions and annotations.

The Trustees of the British Museum not only recognised the importance of the enterprise as an aid to scientific research and as a means of increasing the usefulness of the libraries of Great Britain and Ireland, but also, on the recommendation of Dr. Pollard, then Keeper of Printed Books at the British Museum, supported by Sir Frederic Kenyon, Director and Principal Librarian of the Museum, they allowed the compilation of the list to be undertaken by the staff of the Museum as part of their official duties.

It soon became apparent that the magnitude of the work undertaken was such that the cost of preparation and publication could not be covered by subscriptions and sales. At this point, Sir Robert Hadfield and Mr. Robert Mond gave provisional guarantees to enable the work to proceed. The Trustees of the Carnegie United Kingdom Trust then guaranteed the sum of 1000*l.* towards the cost of production, on the condition that the number of centres with important libraries to be dealt with in the list should be greatly increased. This change in the original plan considerably increased the cost of preparation. Early in 1923 the Conjoint Board of Scientific Societies came to an end, but before its dissolution it entrusted "The World List" to Sir Arthur Schuster, Mr. Robert Mond, and Dr. P. Chalmers Mitchell, who undertook to form a company limited by guarantee to complete, own, and conduct the World List. Such a company was duly incorporated with a council of management consisting of Dr. P. Chalmers Mitchell (chairman), Sir Arthur Schuster, and Mr. Robert Mond. Miss Joan B. Procter became secretary. The original Committee was appointed as Advisory Committee, so that, except for the formal change in ownership and responsibility, there was no break in the control.

The actual compilation has been carried out, under the direction of Dr. A. W. Pollard, by Mr. W. A. Smith and Mr. L. A. Sheppard. Mr. Leonard Wharton has helped with the Slavonic entries. The periodicals catalogued are not only those in British libraries, but also all those concerning which information could be obtained from any part of the world.

Very special thanks are due to the Trustees of the British Museum and to the Keeper of Printed Books for allowing this work to be done by members of the staff of the Museum. It should, however, be mentioned that Dr. Pollard points out that it is only in very exceptional circumstances that any library can undertake to catalogue books not contained within its walls. He therefore suggests that there is a real need for a small "flying squad" of trained cataloguers and bibliographers who would help to make the wealth of books in English libraries available for students.

The actual list now published contains the titles of 24,128 periodicals. This is really a remarkable figure, when it is remembered that the number of periodicals indexed by the International Catalogue of Scientific Literature is only about 9000. In arranging the titles inessential words are disregarded and words regarded as unnecessary are cut out. The care with which these abbreviations have been made is, on the whole, judicious, but it is surely a mistake to change plurals into singulars in all the large headings. The title of the *Comptes rendus* is given as "Compte rendu hebdomadaire des seances de l'Academie des sciences, Paris."

This change from plural to singular is made in order that the periodicals beginning *Compte rendu* may be classified together with those beginning *Comptes rendus*. There are no less than ninety journals beginning with these two words either in the singular or in the plural, and the compilers evidently disliked having one list of journals beginning *Compte rendu* followed by another list beginning *Comptes rendus*. The "World List of Scientific Periodicals" will for a long time be the standard work to which authors will refer when anxious to quote the exact title of a journal. In these circumstances it is desirable that the titles given should be quite accurate in the list, and that any difficulties in classification should be overcome by laying down some general rules such as "In fixing the alphabetical order of the titles indexed, the plural 's' is disregarded." This would be on a par with the plan adopted in Watts's "Dictionary of Chemistry," where the prefixes "bi-," "tri-," etc., are disregarded so that bicarbonates and carbonates may come together.

The volume now published contains a numbered list of scientific periodicals. The scope of the term "scientific" is that laid down in the International Catalogue of Scientific Literature. The present volume does not give indications of the libraries in which the periodicals may be found. A second volume, to be issued shortly, will contain a list of numbers corresponding to the numbers allotted to the titles in this volume, followed by a standard abbreviation of the title and reference letters indicating the libraries filing each periodical.

An exceedingly valuable addendum to the list is a catalogue of international congresses. It is most

necessary that scientific workers should know how to get access to the accounts of papers read and discussions held at these congresses and conferences. Hitherto, there has been nothing approaching a complete list of these publications, still less any indication as to where they can be consulted. Mr. Gomme, of the Patent Office Library, has given much personal attention to the preparation of this catalogue of proceedings at international congresses. All who are interested in the advance of scientific knowledge will be grateful to him for the care he has given to this section.

Our thanks are due to all those who have ungrudgingly given time and thought to the successful working out of this great undertaking, and to those who gave financial assistance when the project seemed likely to fail from lack of funds to carry it on. Dr. P. Chalmers Mitchell, who signs the preface, has evidently been the driving force ready at all times to meet and overcome difficulties as they arose. The task has been great, but those who undertook it have resolutely set themselves to accomplish it and have brought it to a successful issue.

Jungle-Folk of India

The Birhors: a Little-known Jungle Tribe of Chota Nagpur. By Rai Bahadur Sarat Chandra Roy. Pp. viii+608+36 plates. (Ranchi: *Man in India* Office, 1925.) 10 rupees; 15*s*.

THE Birhors dwell in the jungles which fringe the eastern margin of the great central 2000 ft. plateau of Chota Nagpur, in the Province of Bihar and Orissa. Like so many other primitive communities, they seem doomed to perish under the impact of modern life; between 1911 and 1921 their number fell by more than 30 per cent. (from 2340 to 1510). Mr. Roy's monograph is a timely record of a dying race.

Some of the Birhors are "settled," and eke out a livelihood by burning patches of jungle and raising a scanty crop of maize and beans. But their normal mode of life, to which even settled Birhors often revert, is nomadic; the fauna and flora of the jungle supply them with food and with the *chōp* fibre (*Bauhinia scandens*) which they make into rope and barter for such clothing, condiments, etc., as they cannot produce themselves. The Birhors eat almost anything; whether they ever ate their ancestors, as commonly alleged, is an open question; the case against them is not yet proved.

Racially the Birhors resemble the more virile Mundas and Oraons of Chota Nagpur. Their language is a dialect of that Austric family which straggles round half the globe from Madagascar to Easter Island. Their social organisation, as elsewhere in India, is based on clan exogamy; but in the economy of daily life the kin-group yields precedence to the clan-group or *tāndā*, a word applied also to the encampments of Lambadi (Banjari) gipsies who were once the carriers of peninsular India and the Punjab. The *tāndā* consists of from 3 to 10 families, belonging to various clans associated together for subsistence. Each *tāndā* has its captain (*nāyā*), its magician (*māti*) and its messenger (*diguār*), its own spirits (*sāngi bhūt*), and its own hunting expeditions. Mr. Roy explains in detail their hunting ritual and the partition of the spoil. Once a year several *tāndās* unite in a "regional hunt"; otherwise inter-*tāndā* relations are limited to wedding festivities and adjudication on infractions of tribal law.

The clan system, as usual, regulates matrimony. Mr. Roy names thirty-seven clans, and the list is not exhaustive. Most of the clan names are "totemistic," but some connote localities and some clans bear the names of alien castes and tribes, which indicate some infusion of alien blood. Each clan has its peculiar traditions, observances, and cults, and several clans are admittedly of hybrid origin. Broken folk cannot afford to be exclusive.

Lads and lasses are schooled by the familiar "dormitory" discipline of primitive culture. The dormitories are not exactly shrines of purity—boys will be boys,—but schoolboy etiquette insists that a lad should stick to his own sweetheart and not poach. With marriage comes respectability. Of marriage there are ten forms, nine of them informal and gallant, the tenth only is "regular," heavily laden with the elaborate negotiation and formalism in which India delights.

Mr. Roy's appraisement of Birhor religion is kindly and sound. He rightly discriminates between "personal" gods and spirits propitiated with prayers and sacrifices, and impersonal "powers, forces, or energies" controlled by spell or threat or other "magical" device. Religion to the Birhor is not all gloom and terror. Singbōngā, the supreme being, is benign enough, but, like other superior personalities, somewhat aloof. Then there are hosts of clan spirits, *tāndā*-spirits, family spirits (mostly ancestral), tutelary spirits, etc., whose censorship of moral lapses must exercise a salutary influence on social life. Mr. Roy's outline is clear and concise, and he neatly sums up the *summum bonum* of Birhor existence: "the power to control and direct the *impersonal* energies and powers and the stray *personal* powers—and secure the goodwill of the more important *personalised* powers or spirits."

In Birhor belief a man has two souls, one male, one female. When he dreams, the male soul quits the body, the female soul remains in charge, and the body

sleeps But if the male soul lingers, its mate goes out to search for it, and the body dies, temporarily, perhaps, for the spirit-doctor (*māti*) is requisitioned and does what he can to call back the truant souls and restore life

The Birhors are by no means untouched by Hindu influences, markedly so in the few religious festivals celebrated by certain clans, and in folk-tales of which Mr Roy gives numerous examples The Birhor version of the Rāmāyana is of special interest

Students of Indian anthropology are deeply indebted to Mr Roy for the light he has thrown on the past and present culture of the Chota Nagpur plateau In the Bihar and Orissa Research Society's Journal he has opened up new ground in the archæology of his area His monographs on the Mundas and Oraons are classics "The Birhors" is yet another first-rate study, a study not merely of an obscure tribe but also of the workings of that mysterious complex of thought and feeling which go to make up human culture The volume is handy in size and easily read, in spite of the numerous misprints inseparable from Indian typography The plates are well chosen, but not too well printed Mr Roy is never a theoriser or a partisan, his diction is simple and precise, his inspiration comes straight from the hearts of the humble folk he has made his friends

F J RICHARDS

Research at High Temperatures

Fours electriques et chimie Publie sous la direction de Prof P Lebeau, avec la collaboration de C Bedel, Prof A Damiens, P Fleury, Prof P Jolibois, Dr M Picon, Prof G Ribaud, Dr H Weiss (Fondation Edmond de Rothschild pour le developpement de la recherche scientifique) Pp xii + 585 (Paris Les Presses universitaires de France, 1924) n p

THE Committee of the Fondation Edmond de Rothschild has caused this book to be written as a preliminary step in the planning of investigations with electric furnaces, to extend scientific knowledge and industrial applications It forms a review of electric furnace constructions and their applications and succeeds in covering the ground fairly thoroughly Recognising that advances in chemistry and physics are frequently closely associated with the invention or development of new apparatus, an attempt is made to describe various types of electric furnace and to associate with the several forms a summary of the main researches already carried out by their aid

Such a compilation has both its advantages and its dangers Bibliographical surveys, or *documentation* as the French so aptly describe them, undoubtedly save the investigator a lot of tedious work, and literary searching is not only wasteful of the time, but actually detrimental to the originality of the more able scientific worker

On the other hand, there is a real risk that too much attention will be paid to the acquisition of replicas of the apparatus of the earlier workers, without due regard to the more important part which the inspiration and skill of these investigators played in its design and use The history of the scientific application of electric furnaces itself provides an excellent example of the power of the able experimenter to override all limitations in apparatus and equipment The late Henri Moissan is even to-day unsurpassed in the richness of his discoveries in this field and yet he had, for almost the whole period during which he was engaged in these researches, only the most simple equipment and the only supply of electric current in his laboratory was that which he could provide from primary batteries, the electric furnace work being carefully prepared beforehand but executed on occasional pilgrimages to a central supply station, several miles away from the laboratory

Whereas the work of Moissan was concerned chiefly with the primary survey of the subject and the production of metals and new compounds, hitherto outside the practical scope of ordinary methods of heating, later applications have called for apparatus of greater precision The need for close control of the working temperatures, as in the determination of such physical constants as the boiling points of the metals, for heating *in vacuo* to prevent the oxidation or the carburisation of metals, or for high pressure to attain measurable yields of some of the products of high temperature chemical reactions, has in each case led to the design of much more complicated apparatus The description of this apparatus is fully dealt with in this book in seven chapters devoted respectively to electric furnaces of the following types (1) metallic resistance, (2) carbon resistance, (3) vacuum, (4) high pressure, (5) induction and high frequency, (6) arc, (7) spark and gas discharge, whilst an eighth chapter summarises the methods of pyrometry

With a subject that covers such a wide borderland of physics, chemistry, and electrical engineering, it is not surprising for a reviewer to be able to find a few omissions—such as all mention of the electric furnace production of silica glass—but the survey on the whole is remarkably complete and superior to what is generally provided by French scientific books, and it can be strongly recommended to English workers who have need of a reference book on the subject The Fondation Edmond de Rothschild (see NATURE, 1921, vol 107, p 563) is one of the largest French endowments for

physico-chemical research and the further development of this branch of its activities, which will apparently consist in supporting work to supplement existing knowledge in this field, will be awaited with much interest R S H

Lakes

Les lacs, leur mode de formation, leurs eaux, leur destin elements d'hydro-geologie Par Leon W Collet Pp xii + 320 + 28 planches (Paris Gaston Doin, 1925) 35 francs

THE limnologist is fortunate in having at his disposal two such excellent works of recent date as Prof Halbfass's "Grundzuge einer vergleichenden Seenkunde" and Prof Collet's "Les lacs" Though the subject is the same, there is room for both The mode of treatment is very different and there is little overlapping between the two Prof Halbfass's book is the more general Prof Collet's deals chiefly, though by no means solely, with the lakes of Switzerland and the Alps, and some of these it describes in considerable detail Prof Collet was formerly Director of the Swiss Hydrographical Service, and the accounts that he gives of the observations made by himself or under his direction form a valuable feature of his book He also took part in Sir John Murray's survey of the Scottish lochs

Prof Collet's book is divided into three sections the formation of lake-basins, the water of lakes, and the destiny of lakes Under the last heading he includes not only the filling of lakes by deposition but also the utilisation of their waters The first section occupies about a hundred pages Owing to the somewhat sceptical attitude adopted by some writers in England, the English geologist will probably be most interested in the lakes attributed to glacial erosion and to solution Prof Collet himself has no doubt about the erosive powers of glaciers, and like Penck and Bruckner believes that most of the lakes of the Alpine borders are due to overdeepening where the glaciers debouched upon the plains Lake Geneva, however, has had a more complex history, which has not yet been fully worked out, and only the upper basin is due to this cause In connexion with this question of overdeepening he gives an interesting photograph of the left bank of Lake Ritom It shows glacial striations rising steeply from the water, the direction of the rise being towards the outlet It proves, he thinks, and it certainly suggests, that the glacier itself rose towards the barrier at the lower end of the lake Perhaps, however, even this will not convince the confirmed sceptic, for it is still possible that the greater part of the ice in the lake-hollow may have been stagnant and only the upper layers moving

No geologist denies the efficiency of water as a solvent agent, and in Cheshire, depressions of the surface due to the solution natural or artificial, of the salt beneath, are too common to leave any doubt as to their cause But it is not so clear in England that any lake basins have been formed by direct solution of the rock that occupied the hollow Hollows have been produced in this way in our limestone districts, but they do not usually hold water, for there is generally an underground escape In the Karst, however, and in the Limestone Alps, the conditions are more favourable, and Prof Collet describes several examples In some there is no visible outlet, in others a part of the water escapes superficially and a part underground By means of experiments with fluorescin, Prof Collet has shown that in several cases the subterranean outflow is not in the direction that the surface topography would lead us to expect

The section on the water of lakes occupies 85 pages and deals with the influence of the regime of the affluents, the temperature, the chemical composition, and the colour One of the most interesting parts of this section is the account of Lake Ritom For stable equilibrium the water must increase in density downwards Consequently in temperate regions, when there is no disturbance due to wind or other causes, the temperature of the water in summer decreases downwards, in winter, if the surface water is below 4° C, the temperature increases downwards Lake Ritom sometimes shows a layer of cold water lying between warmer water above and below The condition is due to differences of salinity The upper twelve and a half metres—the measurements were made before the level of the lake was artificially altered—consists of oxygenated water with a low percentage of salts From thirteen metres downwards the water is highly saline and contains sulphuretted hydrogen There is a transition layer of about half a metre in thickness The lower water is almost stagnant and has a temperature of about 6° C, varying little with the depth or with the season The fresher water is never so cold as to become heavier than the salt water beneath, and consequently the convection currents in the former do not extend into the latter The upper layer, in fact, behaves as if the salt water formed the floor of the lake and the temperature at this false floor is often less than 6° C

The salts in the lower water are derived from the dolomitic and gypsum-bearing Triassic rocks of the region, not by direct solution of the walls of the hollow but from underground sources Since the water is nearly stagnant the supply is doubtless very slow—it must, in fact, be so slow that it is balanced by diffusion into the upper layer This upper layer consists of the

water from the visible affluents of the lake, which are all only slightly mineralised, and the fresher water flows over the saline layer and escapes by the river Foos

The third section, consisting of rather more than a hundred and twenty pages, is the most important from the practical point of view, and should be consulted by engineers who have to do with the construction of reservoirs for any purpose All lakes tend to be filled up in time by the deposits brought into them by streams and rivers, and the same is true of reservoirs In a country like Switzerland the process is often much more rapid than in England The original artificial lake of Perolles was filled in fourteen years, and the rate of deposition in other cases is equally high This is one of the matters investigated by the Hydrographic Survey, and though the rate must vary greatly in different cases, the figures which Prof Collet gives are of great value They are, in fact, almost the only figures available which are more than guesses

Sufficient has been said to show the interest of the volume Prof Collet writes very clearly and the book is admirably produced and illustrated There are 63 maps and diagrams and 28 plates of photographs Apparently the paper on which the text is printed is heavily loaded, for though the book is not bulky it is inconveniently heavy This is the only fault that can be found with it P L

Our Bookshelf

The Social and Political Systems of Central Polynesia By Robert W Williamson Vol 1 Pp xxix+438+6 maps Vol 2 Pp v+496 Vol 3 Pp v+487 (Cambridge At the University Press, 1924) 75*s* net

THE amount of labour involved in the writing of this book has been, literally, enormous The bibliography of books covers eleven closely printed pages, and to these must be added innumerable articles in the scientific journals of which the titles alone occupy nearly a page Yet the Sandwich Islands and New Zealand are not included, and except for an opening chapter on origin and migrations, no subject outside what is strictly social or political is discussed Even such matters as the functions of the chiefs in relation to ritual observances are postponed, with other topics connected with religious ceremonies and customs, for future consideration in another work

Within the limits that Mr Williamson has set himself, his treatment has been thorough The difficulties arising out of the often unsatisfactory, and sometimes contradictory, character of the evidence—evidence collected at widely separated periods of time, by individuals of very different powers of observation and of varying capacity for precision of statement—have been squarely faced and usually resolved into a coherent account Mr Williamson's examination of local and social grouping may be taken as a very fair sample both of the difficulties and of the results of his meticulously careful method of analysis Limitations of space forbid any critical examination of conclusions which are based upon a mass of detail drawn from so extensive a field; but it may be mentioned that Mr Williamson finds that the fundamental factor in the social and political system of Polynesia was the recognition of the office of the head of the group, taking this term as applicable to functions ranging from those of the chief of the most extensive area under one authority to the head of a family group Mr Williamson is to be congratulated on the successful accomplishment of a heavy task by which he has earned the gratitude of all students of ethnology

Automotive Electricity a Text and Reference Work on the Construction, Operation, Characteristics and Maintenance of Automotive Ignition, Starting, Lighting and Storage Battery Equipment By Earl L Consoliver Pp xv+665 (New York McGraw-Hill Book Co, Inc, London McGraw-Hill Publishing Co, Ltd, 1925) 20*s* net

ELECTRICITY plays a most important part in the equipment of a modern motor-car In addition to igniting the fuel charges within the engine cylinders, it starts the engine and illuminates the road for night driving It also operates the horn and other signal devices, and in many cases it operates electric gear shifts, hand-warmers, cigar-lighters, and carburettor heating devices It plays an equally important part in connexion with motor-boats and aeroplanes There is a demand, therefore, for a book which will give a clear and trustworthy account of the ignition requirements, the starting and generating equipment, and the management of storage batteries

The volume under notice, whilst disclaiming to be an encyclopædia, does touch pretty thoroughly on all these subjects Naturally American practice is most fully considered, but most of the advice given is directly applicable to all makes of car The title led us to expect that vehicles driven exclusively by batteries would be described and that their limitations would be considered This branch of the subject, although an important one—more especially in the United States—is not considered Many useful hints can be picked up from this book The author has had considerable experience in instructing those who have to look after motor-cars, he gives the minimum of theory and lays stress on those points which are important in practical running

Practical Advice to Inventors and Patentees Inventions and How to Patent Them By C M Linley Pp vi+126 (London Sir Isaac Pitman and Sons, Ltd, 1925) 3*s* 6*d* net

THIS thoroughly practical little book can be strongly recommended to inventors who wish to know how to exploit their ingenuity commercially, for its author appears to have learned the ropes in the hard school of experience The principles of patent law and practice are set forth clearly in non-technical language and the exposition of these is sound, although the following points might be noted for future editions a British patent cannot be invalidated by publication in a prior British specification more than fifty years old (pp 47, 48), while it can be invalidated by publication in a foreign specification taken by the Patent Office library, whether or not there has been additional publication

in a periodical (p 45), and p 44 would be improved by the addition of a paragraph on the gentle art of phrasing disclaimers

It is, however, when he comes to more practical topics that the author is at his best he shows a keen insight into human nature and much ripe wisdom when he explains how to attract a capitalist, how to deal with infringers, how to combine discipline with fair play when inferior workmen become inventive, and how to perform a good many other difficult but profitable feats which are not mentioned in text-books of patent law His anecdotes relating to the history of inventions also make good reading The book is written in a conversational style and is all the more readable on that account, but it would be the better for a thorough revision of its syntax, which is in places slipshod

Methods in Plant Histology By Prof Charles J Chamberlain Fourth revised edition Pp xi+349 (Chicago University of Chicago Press, London Cambridge University Press, 1924) 3 25 dollars

SINCE the first edition of this book appeared in 1901 it has become a well-known manual of laboratory methods Its usefulness may be judged from the succession of editions of continually increasing size The present edition is largely re-written—a task necessitated in part by the stimulus to improvement in technique resulting from previous editions There are additional hints on details of method throughout the book, and these are especially valuable in the field of cytological technique, where success—like genius—depends upon an infinite capacity for taking pains

The Venetian turpentine method for mounting algæ has been made more specific and could doubtless be more widely used with advantage, as the staining results are brilliant when good preparations are obtained A short chapter is added on the cellulose acetate method of softening woods for sectioning—a method developed by Dr Kernot and Mrs Williamson, which softens the hardest woods without destroying details of structure

The standardisation of American stains, on which a scientific commission has been at work since the War, has led to a great improvement in dyes, which now often surpass the old Grubler stains, and incidentally has led to alterations in the directions for staining given in this book Among the micro-chemical tests we are surprised to find no mention of aniline hydrochloride, which is such a useful laboratory reagent for lignified tissues R R G

An Outline of Automatic Telephony By William Aitken Pp 143 (London Ernest Benn, Ltd, 1925) 5*s* net

SINCE the introduction of automatic working, telephony is becoming more and more a highly specialised science To the outsider the problem appears to be one of the greatest complexity Any telephone in an area has to be connected in a few seconds with any other telephone in that area so that two persons can converse clearly and uninterruptedly for a given period As a mistake in dialling is always possible, the caller must be able to break down the connexion at any instant The cables between any two switching stages may be in use or faults may develop in them Signals therefore have to be given to the caller to indicate abnormal conditions Further, supervisory signals have to be sent to the attendants and the sensitive pieces of apparatus have to be protected by suitable devices Service has sometimes to be free but generally it is either metered or obtained by "coin in the slot" As all these variations have to be done automatically and with the minimum risk of error, the difficulties that arise are unending, and telephone engineers are to be congratulated on having developed working systems Mr Aitken gives a good technical description of the various types of systems in use, particular stress being laid on the Strowger Director System, which is the one being installed in London The system he adopts of describing the "circuits" is original and easily intelligible

Sulphuric Acid Concentration By P Parrish and F C Snelling (Chemical Engineering Library, Second Series) Vol 1 By Hot Gases Pp 141 Vol 2 In Heated Vessels Pp 147 (London Ernest Benn, Ltd, 1924) 6*s* net each

THE chief merit of these two small volumes is that they are written by practical men who possess a ripe and successful experience of sulphuric acid manufacture For this reason they will be read and studied with profit by the works' chemist and engineer, whilst the fact that they contain a considerable amount of information which is not found in ordinary text-books will make them appeal to the teacher and student in technical institutions From the educational point of view, however, they have one drawback, namely, defective composition there is scarcely a statement in them which could not be put into clearer and terser English, but even this could be turned to good purpose by a capable teacher

The accounts of the Kessler and Gaillard methods of concentration in the first volume, and of cascade systems in the second, are particularly useful, and, like the rest of the subject-matter, quite up-to-date from the point of view of British practice Two chapters are devoted to constructional materials, and one to transport and storage In the final chapter on possible developments, the view is expressed that in the future "chamber" acid (70-80 per cent) and oleum will be produced simultaneously in one plant, and rectified acid (96-98 per cent) will be obtained by mixing them on the spot

The Wandering Scholar By David G Hogarth Pp v+274 (London Oxford University Press, 1925) 8*s* 6*d* net

THIS book is neither a reissue nor a new edition, but in part is both It is a combination of two books, "The Wandering Scholar" and "The Accidents of an Antiquary's Life," one published in 1896 and the other in 1910 Of the first, two chapters and some paragraphs are omitted, of the second, the introductory chapter The account of the Anatolian Turk under the old Hamedian regime, a piece of description and psychological analysis of remarkable penetration and insight, is retained Those, if any, who are unacquainted with these delightful sketches of travel and archæological exploration in Asia Minor, Greece, and Egypt, with their humour and their sympathetic appreciation of the people of each country, will be grateful for their reissue in the convenient form of a single volume

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE *No notice is taken of anonymous communications]*

The Isotopic Composition and the Atomic Weight of Chlorine in Meteorites

THE most accurate determinations of the atomic weight of chlorine indicate that on earth this element consists of 76 6$_5$ per cent of chlorine of isotopic number 1 (atomic weight = 35) and of 23 3$_5$ per cent of isotopic number 3 (atomic weight = 37) It is of interest to determine the composition of this element in meteorites, and this has been done by the present writers, with the result that meteoritic chlorine has been found to have exactly the above isotopic composition Within the limits of error of extremely accurate work, the atomic weight of meteoritic chlorine is found to be the same as that of this element as found on earth

Presumably the material of meteorites has not been mixed with that on earth within the last few billion years Thus, if during this period there has been any disintegration or formation of atoms of chlorine, it has either (1) not affected at all the relative amounts of the two isotopes, or (2) the relative amounts have been affected to exactly the same extent in both locations The additional possibility that the coincidence is accidental seems to be ruled out by the similar results of Baxter for the atomic weight of meteoritic nickel Have the materials involved ever been mixed with sufficient thoroughness to explain these results? According to Harkins (J Am Chem Soc , 39, 856 (1917), *Phil Mag* , 42, 332 (1921)) the atoms of the lighter isotope are more stable and a large part, if not all, of the exhibited constancy of isotopic composition of elements is due to the net effect of the different types of atomic stability

The average of the best results for the atomic weight of terrestrial chlorine is 35 467 The five results obtained by us on highly purified meteoritic chlorine are 35 466, 35 468, 35 469, 35 469, 35 465, with an average of 35 467$_4$ The method used for the determination of the atomic weight consisted in weighing about two grams of extremely pure silver in a quartz flask, dissolving in nitric acid, and in finally adding hydrogen chloride obtained from a meteorite in sufficient excess to convert the silver completely to silver chloride The water and acids were evaporated and the silver chloride fused, the last fusion being carried out in an atmosphere of chlorine The balance used gave a deflexion of half a millimetre on the scale for a hundredth of a milligram The methods used throughout were similar to those used by Richards and his associates, with the exception that the smaller amount of material available made it essential to use a balance of the highest sensitivity compatible with the requisite stability and constancy

Chlorine from wernerite, from apatite, and from purified commercial hydrochloric acid gave results which were identical with those on the meteorite, within the limits of error of the work

In calculating the percentages of the isotopes as given in the first paragraph, use was made of the Whole Number Rule of Harkins and Wilson (J Am Chem Soc , 37, 1367-1421 (1915)) and the assumption was made that the atomic weights of the separate isotopes are exactly whole numbers While any deviations from these whole numbers affect the percentages given, it is obvious that they do not affect the identity of composition of meteoritic and terrestrial chlorine as exhibited by the identity in the atomic weights of the mixtures from the two sources

WILLIAM D HARKINS
S B STONE

University of Chicago,
August 11

Coastal Errors in Radio Direction-Finding

FOR many years now it has been the experience of those dealing with wireless direction-finders that when the path of the waves being received lies approximately parallel to the coast, an error in apparent bearing is obtained which may or may not be constant It is probably correct to state that the error is always such as to indicate that the waves in crossing from sea to land experience a deviation in a direction towards the normal to the coast-line at a point of transit This is consistent with the generally accepted assumption that the velocity of waves over sea-water is greater than the velocity over land due to the lower conductivity of the latter The magnitude of the possible error which may occur appears to be usually of the order of 3° to 5°, although greater errors up to about 10° are apparently sometimes experienced

While a fixed transmitting station should, in the absence of night variations, give a constant bearing even including any coastal refraction effects, a little consideration of the case will show that several stations at different distances on the same great circle from the D F stations will give different errors It is thus evidently impracticable to apply a correction to the observed bearing of a ship at a D F station without assuming a knowledge of its true bearing and distance, and it is becoming the practice of those in charge of shore D F stations to supply information as to the arcs over which the bearings supplied may be considered to be reliable

In the experimental direction-finding work conducted by me during the last four years, errors have been measured in certain cases which appear to support the above experience At one D F station situated on the east coast of England, the only cases in which consistent errors of more than 1 3° were obtained in daylight, were found to be those for which the direction of transmission was within 20° of the coast-line On the wave-lengths of 450 and 600 metres employed in the majority of these particular observations, this coastal error was of the order of 3° to 4 3° for some of the transmissions In one instance, in which the wave-length was systematically increased from 500 to 2600 metres, the corresponding error decreased from 3 2° to 1 4° On higher wave-lengths the possible coastal error observed in this and all other cases was less than 1° In every instance the error was such as to indicate a bending of the waves towards the normal to the coast-line, in passing from the sea to the land side of the boundary

From Zenneck's analysis (J A Zenneck, *Ann der Phys* , 1907, vol 23, pp 846-866) of the case of a plane wave travelling over the plane boundary of a semi-conducting ground and non-conducting air, it can be shown that the velocity of wireless waves in a horizontal direction is greater over land than over sea Hence the effective refractive index, which is the ratio $\frac{\text{velocity over sea}}{\text{velocity over land}}$, is less than unity, and a wave will be bent away from the normal in crossing

a coast-line from sea to land Eckersley (T L Eckersley, *Radio Review*, 1920, vol 1 pp 421-428) has previously made a study of the refractive effects for wireless waves crossing the Egyptian coast from the Mediterranean Sea and obtained experimentally a refractive index of 1 02 for a wave-length of 1000 metres A theoretical value of 1 067 was given as being applicable to this case but in view of the above remarks a mistake would appear to have entered into the derivation of this value

It has been shown from recent measurements (R L Smith-Rose and R H Barfield Proc Roy Soc, 1925 vol 107, pp 587-601) that the effective conductivity of the ground in the south of England at wireless frequencies is approximately 10^8 e s u If this value be used to calculate the refractive index for the English coast taking the wave-length of 450 metres, the value of μ obtained is 0 999991 This means that the ratio of the velocities of these waves over the sea and land differs from unity by less than 10^{-5}, and it is thus difficult to account for the deviations which have actually been observed quite apart from the fact that they are in the wrong sense It must be remembered, however that in such a case the deviation $\delta\phi$ of a wave crossing the boundary at an angle of incidence θ can be shown to be

$$\delta\phi = \frac{\mu - 1}{\mu} \tan \theta$$

Hence, although $\mu - 1$ is only 10^{-5} for the case considered above, $\tan \theta$ tends to become infinite as θ approaches 90° So that in the case of waves which pass along the coast at practically grazing incidence for a distance of several miles, the error may reach a value of two or three degrees as actually observed Two difficulties in making a strict comparison with experimental results are that the coast-line is not usually straight for any appreciable distance, and that it is doubtful in many cases if the effective boundary between the sea and land is defined by the high-water mark used on charts For these reasons the angle of incidence of the waves on the coast-line is a rather uncertain quantity The conditions are further complicated in many instances by the waves

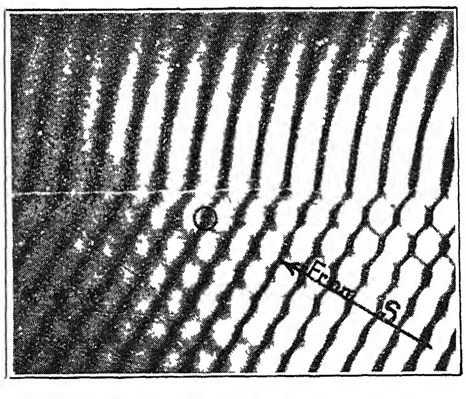


FIG 1—Ripple photograph Source S and observing station O on same side of boundary Conditions at O are complicated by the presence of a reflected wave in addition to the direct wave from S

having to cross several coastal boundaries between transmitter and receiver, and a cumulative action may result

It was suggested by Eckersley that it is necessary to be a few wave-lengths away from the boundary in order to allow the wave-fronts to settle down, before the angle of refraction can definitely be measured Since the land D F stations are often situated within a wave-length of the boundary, it is important to know exactly what is happening at such a short distance Providing the change from one medium to another at the boundary is reasonably sudden, there appears to be no reason for supposing that the deviations of waves crossing it is not equally

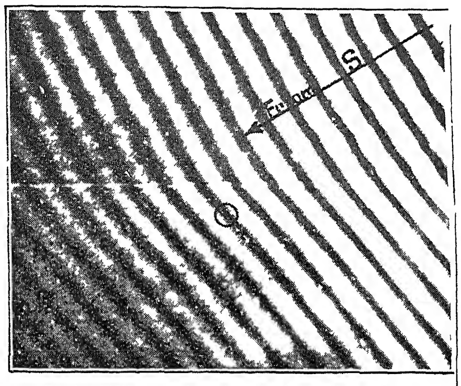


FIG 2—Ripple photograph Source S and observing station O on opposite sides of boundary The wave front observed at O is not at right angles to the true bearing of S

sudden This point has been very nicely demonstrated by the analogous case of water ripples in which the change in velocity is produced by an alteration in the depth of the water in the ripple tank The photograph reproduced in Fig 2 shows that the change in direction is quite sudden and is complete within a fraction of a wave-length Should the change in conditions from one medium to another be gradual, the resulting refraction will be equally gradual, and at the boundary the observed deviation should be always less than the total deviation produced at a sufficient distance from the boundary for the refraction to be complete

In many of the cases noted by me it appeared that the direction of arrival of the waves was entirely over-land, and thus any deviation could scarcely be ascribed to refraction It was pointed out by Dr A H Davis, of the Physics Department of the National Physical Laboratory, to whom I am indebted for the accompanying ripple photographs that the internally reflected wave might be important in such a case The effect of this wave in the case of water ripples is demonstrated in the photograph reproduced as Fig 1, in which the waves are approaching the boundary from the same side as that on which the D F observing station is situated It is evident that the apparent direction of the waves arriving at O may be altered by an appreciable amount and in the same direction as that caused by refraction, as in Fig 2

Although this certainly directs attention to the fact that a direction-finder may be liable to errors on waves arriving on both the land and sea side of the coast there is still the same difficulty in explaining the matter on theoretical grounds For, with the value of μ deduced above the amplitude of the reflected wave will be very small except in the case of total internal reflection, which will not occur until the angle of incidence is nearly 90°

R L SMITH-ROSE

The National Physical Laboratory,
Teddington,
August 25

Sex-determination in *Trialeurodes vaporariorum*

THE common Greenhouse White Fly (*Trialeurodes vaporariorum*) presents a rather curious case of sex-determination Originally (1903) Morrill in America discovered that it was parthenogenetic and that all unfertilised eggs developed into males, this finding was corroborated later on by Stoll and Shull (1919) Hargreaves (1914) and Williams (1917), investigating the same species in England, found, however, that in this country unfertilised eggs laid by virgin females exclusively gave rise to females Random collections in America had shown a considerable proportion of males (40-50 per cent), while in England, none or a few males were found, only one small colony found by Williams at Merton agreed with the American strain with regard to its sex-proportion

These investigations indicate that *Trialeurodes vaporariorum* has two races, an "American" showing arrhenotokous parthenogenesis, and an "English" with thelytokous parthenogenesis, a most interesting fact, which, however, does not seem to be completely unique in the animal kingdom (cf *Trichogramma pretiosa*, a Chalcid, Howard and Fiske 1911) As to the progeny of mated females Williams in the exceptional Merton colony had obtained both sexes after pairing of the mother individual, and therefore thought himself justified in concluding that fertilised eggs may give rise to both males and females Stoll and Shull with individuals of the "American" race arrived at the same experimental result, but maintained that the interpretation might be the same as in the honey-bee where the queen after mating can lay both fertilised and unfertilised eggs developing into females and males respectively Furthermore it seemed probable that this is really the case, for they obtained in some experiments a great majority of females after mating, while if Williams's interpretation was the right one, no more than 50 per cent should be found Nothing has been published about the result of mating in the "English" race

Schrader (*J of Morphol*, 34, 1919) has investigated the cytology of the "American" race and made out the following facts The haploid chromosome number is 11, the diploid 22 In all eggs pseudo-reduction is completed and consequently only 11 chromosomes are seen in the maturation divisions All eggs show two maturation divisions and undergo reduction Unfertilised eggs give rise to males, which are haploid Fertilised eggs develop with the diploid number to females In the spermatogenesis the haploid chromosome number is retained without further reduction, Schrader believes that the reduction division has been eliminated and only the equation division left, but one can scarcely consider this proved

Thus the sex-determination and cytology of the "American" race in all essentials present the same features as the honey-bee, but the case is much clearer because the perplexing coupling and breaking-up of the chromosomes, which are met with in the bee, are not present in Trialeurodes

I have investigated *T vaporariorum* in Denmark and my main results are as follows In Danish greenhouses I have found both the "American" race and the "English" race, and also mixed populations, more often the "American" As to the latter, I can confirm the results of the previous workers With the "English" race I have made a great number of breeding experiments which show that this strain is exclusively or almost exclusively female-producing Here it must suffice to mention that in three clones any of them descending from a single female, 2398 females and 1 male appeared in the course of three generations Attempts at crossing females of the "English" race with males of the "American" gave in all experiments together in F_1 766 females + 1 male, in F_2 (parthenogenetic progeny of F_1) 999 females and 4 males (Probably the males which only appeared in 2 lines of 11, have originated from slight contamination of the initial material with "American" females) Then even after the "crossing" the female-producing strain persists, *i e* probably no effective crossing has taken place It is very likely, though hitherto not proved, that the rare males in the thelytokous strain do not differ genetically from the males of the arrhenotokous race Therefore instead of speaking about two races, one might just as well say that *T vaporariorum* has two kinds of females obligatorily parthenogenetic thelytokous and facultatively parthenogenetic arrhenotokous together with haploid males

The cytological examination of the thelytokous females shows that the oogenesis up to a certain point goes on in just the same way as in the arrhenotokous ones The chromosome number is the same, the usual leptotene and pachytene stages are met with in the prophase, a pseudo-reduction takes place, thus only 11 chromosomes are seen during the maturation divisions, two polar nuclei are produced in short, the egg behaves just as if it was preparing for fertilisation or development with the haploid chromosome number But afterwards the 11 chromosomes divide, and in all segmentation nuclei and later on in the larval mitoses 22 chromosomes always are found So close a resemblance in the behaviour of the chromosomes within the same species between obligatorily parthenogenetic eggs and eggs that can be fertilised has been found in scarcely any other animal

For further particulars and discussion I must refer to my detailed paper which will probably be published in the course of the winter In the same paper will appear an examination of the cytology of *Aleurodes proletella*, in which species I have been able to prove that really only one maturation division occurs in the spermatogenesis of the haploid males, together with an investigation of the parthenogenesis in the coccid *Lecanium hesperidum*

MATHIAS THOMSEN

Royal Veterinary and Agricultural College,
Copenhagen, August 19

Science in Poland

THE courteous notice in your columns, on August 1, p 168, of vol 5 of the Polish annual *Nauka Polska* is admittedly based on the scanty French abstract contained in the volume itself, and not on the original Polish contributions May I, therefore, claim the hospitality of your columns for a brief supplementary statement?

The writer of the notice, sympathetically as he deals with the endeavours to "prepare the conditions for a scientific advance" in the new Poland, could not be expected to give due emphasis to the fact that these endeavours are the continuation of a solid and unbroken tradition which existed in the old Poland before the partitions ever since the Middle Ages and the Renaissance, and never became extinct during the century and more of Poland's subjection to other Powers Of the six universities of the new Poland mentioned in the notice, Cracow University, founded in 1364, has continued its work without any interruption for five centuries and a half the Polish University of Warsaw, changed by the Russian Government into a Russian one, has been re-established as a Polish university since 1916 Wilno had had a Polish

University since the second half of the 16th century this passed through a period of great splendour in the early 19th century shortly after the partitions of Poland, and it has been revived now; Leopol (which the Germans call Lemberg, and the Poles Lwow) celebrated its 250th anniversary as a Polish university in 1912.

Volume 5 of *Nauka Polska* being devoted especially to the movement called *regionalism*, prominence has been given in it (and accordingly, in the notice in NATURE) to local scientific societies in smaller provincial towns; but the fact must not pass unmentioned that learned societies for the promotion of research existed and flourished through all the vicissitudes of foreign rule in the 19th and early 20th century in such important centres of Polish life as Cracow, Warsaw, Poznan (Posen), Lwow (Lemberg), and Wilno.

Readers of NATURE before the War must have been familiar with the names of such Polish scientific workers as Smoluchowski in the field of physical science, Natanson in natural philosophy, Cybulski in physiology, Marchlewski in chemistry, Zaremba in mathematics, Nussbaum-Hilarowicz in biology—to mention only a few. Some of these men continue their work in the new Poland after the War. Others—like the lamented Smoluchowski—have since been taken from us, but new men are stepping into the breach year in year out, from among the 40 000 university students of the new Poland. It is surely a proof of zeal for scientific research under the great difficulties which all countries experience after the War, and of which devastated Poland has more than her share, that of about 100 papers read at the International Geographical Congress in Cairo in 1925, no fewer than 22 were by Polish authors.

The writer of the notice in NATURE refers to the handicaps created by "restricted finance", but it is a source of pride and gratification to every Polish scholar and scientist that restrictions in the Polish budget have been exercised mainly in departments other than that of education and the endowment of research; this section of Polish State expenditure, in fact, has never ceased to increase in proportion to the rest since Poland has come into renewed existence, and it represents upward of one-sixth of the total expenditure of the State in the current administrative year. With State assistance on a large scale supplementing the private efforts in the way of the organisation of research in Poland, many new institutions have arisen since the War, such as the Geological Institute in Warsaw, which has done very useful service to the nation and to science in mapping out the mineral resources of Poland.

May I mention, finally, that Polish research bodies, like the Academy of Sciences at Cracow, regularly publish abstracts of the research work of their members in the shape of French, English and German bulletins, and that English, in particular, has always figured rather prominently in the publications of the natural science section of the Academy.

R. DYBOSKI.

Royat, Puy-de-Dome, France,
August 23.

Electric Discharge in Gases at Low Pressure.

A PAPER by Mr. McCurdy in the *Phil. Mag.* for November 1924 has recently come to my notice, and I shall be glad if space can be afforded me to correct certain statements made in it regarding the results of my work. I have also read with great interest the joint paper by Messrs. Compton, Turner and McCurdy in the *Phys. Rev.* for December 1924, and wish to make a few comments on the subject now, leaving a further discussion of the result of my work on the nature of electric discharge through gases at low pressure for the Indian Science Congress to be held in January next.

Mr. McCurdy's information that my experiments under Sir J. J. Thomson pointed to the conclusion that striations cannot be obtained in pure nitrogen is, I regret to say, not correct. Not only did I get striations in pure nitrogen, but even in carefully purified helium—the purity of the helium being unquestionable—striations could be obtained. In argon, the absolute purity of which was not very carefully tested, remarkable striations could be obtained. The accompanying diagram (Fig. 1) illustrates three argon striations, each consisting of two entirely detached parts, one the pink spherical glow showing the red spectrum of argon, and the other the bluish-green convexo-concave glow showing the blue argon spectrum. These two glows, however, appear connected to each other at higher pressures by a faint glow.

FIG. 1.

In fact, after having worked with pure hydrogen, helium, neon, argon, nitrogen, oxygen, chlorine, iodine, I came to the conclusion that striation can be produced in all pure gases, though the ranges of pressure and current density in the discharge tube suitable for the production of striation vary widely for different gases. I must confess that I did not try the effect of discharge in pure mercury vapour, but indirectly, by introducing traces of mercury vapour in pure unstriated helium discharge, I did get beautiful and well-defined mercury striations which began to appear one after the other from the cathode end of the positive column with increasing amounts of mercury vapour.

A careful study of the discharge in pure helium under different conditions and with the help of the rotating mirror points to the conclusion that the phenomenon of discharge is essentially intermittent, and that the conditions at the cathode and anode are of the same kind but of different intensity; it means that the positive ions and electrons or negative ions are ejected from the electrodes in regular pulses and move in opposite directions with different velocities. On this view the space charge or concentration gradient, as stated by Prof. Compton and others in their paper, can be easily understood.

The experiments cited to confirm the theory that a reduction in the concentration of the excited atoms helps the formation of striations do not appear to be conclusive. For example, the selective reduction of W_2O_3 can also be easily explained by the fact that the concentration of ions and electrons in the luminous region is greater than in the darker regions, and that due to the consequent effect of more frequent elastic collisions and to the existence of potential gradient between the axis of the discharge tube and the glass walls, more dissociated hydrogen ions reach the glass wall in the region of the striæ than of the dark spaces. Then again, even granting that the suggestion of striations noticed with increasing quantities of helium contamination in mercury was due to impurities and not a real effect, the conclusion drawn from the effect produced by helium, which is an inert monatomic gas of high ionisation potential, is inconclusive unless a comparative study of the effects of the addition of an electronegative gas and of pure nitrogen in similar circumstances is made.

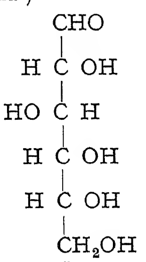
I believe, however, that a decrease in the concentration of the excited atoms and in the mobility of the negative carriers—both effects very likely produced by the presence of negative ions—help to bring out well-defined striations, especially when the electronegative and the electropositive ions have strong chemical affinity for each other

I shall now endeavour to publish the account of my work, as I have finally given up all hopes of getting suitable opportunity to perform further experiments on the subject done in the Cavendish laboratory between 1920 and 1922 B N BANERJI

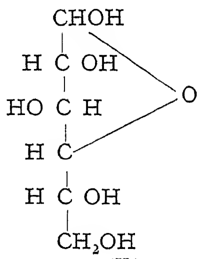
Meteorological Office, Simla,
India,
August 5

A Revision of the Structural Formula of Glucose

HITHERTO the balance of evidence as to the glucose structure has favoured the adoption of a γ-oxide ring formula (II) which it is now customary to describe as a butylene- or 1 4-oxide structure The property of mutarotation of sugars and the analogy which has been drawn between reducing sugars and their α- and β-methyl glucosides led to the abandonment of the older aldehyde formula (I) for glucose in favour of (II)



(I)

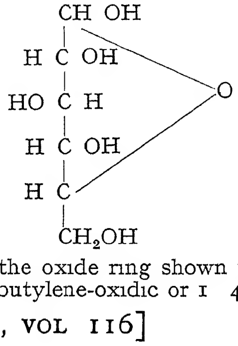


(II)

Whilst chemists have accepted the second of these formulæ as consistent with the experimental facts, yet it must be acknowledged that no direct proof of this structure has ever been advanced, and thus the allocation of a constitution to the commonest hexose rests mainly on the supposed analogy of the sugar with its related lactone, namely, gluconolactone

In the aliphatic section of the Annual Reports of the Progress of Chemistry for 1924, published by the Chemical Society, the present writer expressed the opinion that current views regarding the formula of glucose would probably require revision Meanwhile new evidence has been contributed by investigations conducted in these laboratories, and will shortly be published in detail, showing that normal tetramethyl glucose gives a δ-lactone on oxidation, whilst the corresponding γ-lactone is derived from the γ-sugar

These results necessitate the adoption of the following constitutional formula for ordinary glucose



In this formula the oxide ring shown in (II) is displaced from the butylene-oxidic or 1 4 position, and the attachment is that of a six-membered ring—that is, a 1 5 or amylene oxide, and as this has been shown also to apply to galactose, mannose, xylose, and arabinose, the generalisation is reached that all aldoses exist normally as amylene oxide forms The γ-sugars of the aldose type must be regarded as butylene oxides

Since glucose is an essential unit in most of the natural carbohydrates such as cane-sugar, maltose, lactose, starch, cellulose, it follows that the constitutional formulæ of these substances must undergo revision in the same sense W N HAWORTH

Armstrong College
(University of Durham),
Newcastle-upon-Tyne, August 22

Compton's Theory of X ray Scattering

READERS of NATURE may be interested in a short account of two experimental tests of Compton's theory of scattering which at present are being carried out here Both of these tests deal with the total energy of the recoil electrons produced by hard X-rays

One method is to compare the ionisation produced by the rays in very small (0 5 c c) air-ionisation chambers of different light substances (pure metals and salts) The ionisation in such small chambers is due solely to the secondary electrons from the walls If these secondary electrons all had been of the photoelectric type, their number and therefore the ionisation would have been proportional to the third power of the effective atomic number of the wall substance Thus, for example, the ionisation in a magnesium chamber should have been $8\left[=\left(\frac{12}{6}\right)^3\right]$ times larger than the ionisation in a graphite chamber Experiments show that for hard X-rays the ratio is considerably smaller, decreasing rapidly for decreasing wave lengths For the hardest X-rays which we have produced, the difference between the two chambers is only about 15 per cent For the γ-rays there is no measurable difference This decrease is due to the production of the recoil electrons, the energy of which is independent of the atomic number, and, as I have shown (Proc Nat Acad Sci, 10, p 441, 1924, *Zeit fur Phys*, 29, p 374, 1924), this energy can readily be determined by such measurements For very hard X-rays ($\lambda < 0\ 15$ Å U) our experiments verify Compton's theory to within experimental errors, which may amount to about 10 per cent

In the second method, we measure the true absorption of hard X-rays in light substances like water Under our experimental conditions, this true absorption is practically due solely to the production of the recoil electrons The method consists in measuring the reflection of a very wide bundle of approximately parallel (and homogeneous) rays from the surface of a large mass of the substance, and measuring also the intensity of the rays at different depths under the surface The difference between the incoming and the reflected energy must equal the energy absorbed in the substance, this amount being obtained by multiplying the average value of the intensity in the substance by the coefficient of true absorption By introducing a correction for the photoelectric absorption, the absorption corresponding to the production of the recoil electrons is thus derived

For water and very hard X-rays ($\lambda < 0\ 15$) we here also verify Compton's theory to within the experimental errors (about $\pm$ 10 per cent) (Compare *Phys Rev*, 25, p 581, 1925)

It is a pleasure to acknowledge the assistance of Drs O Glasser and K Rothstein in the experimental part of the investigation here described

HUGO FRICKE

Department of Biophysics,
Cleveland Clinic Foundation,
August 14

The Motion of Whales during Swimming

REFERRING to Dr Petersen s article on this subject in NATURE of August 29, p 327, I may perhaps be allowed to say that during the course of a voyage in one of the Castle line of steamers to the Cape of Good Hope some years ago, I had the opportunity of closely observing the motions of a small group of dolphins each perhaps about six feet long which continued to swim near the surface of the water at the same speed as, and at a distance of between five and ten feet from the side of the ship, for possibly ten minutes I was standing directly above them , the water was perfectly clear , they kept practically the same relative positions with regard to each other and to the ship, the ordinary speed of which was about 16 miles an hour and they appeared to glide through the water without any effort or any other motion of their bodies except a continuous movement of the head from side to side to a distance of perhaps two inches or less on each side of their line of projection, involving, I assume a corresponding movement of their centres of gravity in the opposite direction The duration of this movement of the head for a complete cycle did not exceed, and may have been less than one second

The movement of the rudder in a little boat which according to Dr Petersen may produce 'a slight speed, if the motions towards the central position are the strongest," lacks the one thing needful to make it a rational means of propulsion, namely, a to-and-fro movement of its axis of suspension slightly in advance of the movement of its hinder end in the same direction at one point of its course and in the opposite direction at another This double movement is, I suggest, the means of propulsion employed by the dolphin , effected simply by the snake-like bending of the flexible part of its body

I formed the opinion that the whole of the flexible part of the dolphin s body took an active and strenuous part in the act of propulsion, that, owing to the great resistance offered by the water when being passed through at the rate of more than 20 feet per second, only slight movements were required to give the necessary impetus , and that, in these circumstances, the function of the tail-fin was to provide a thin terminal edge to the body, in the wake of which the water through which it had passed could again coalesce with the least possible degree of turbulence and loss of energy

W GALLOWAY

17 Park Place
Cardiff, September 1

The Scale of C Subminor

AN attempt to reconstruct the Soft Diatonic mode leads to the following nine-note scale, which combines perfectly with the diatonic scale with the exception of F (3 4),—the key-note, dominant, leading-note and octave being identical in the two scales The intervals are given in logarithmic cents The fifth column gives Tartini's *terzo suono* and Thomas Young's fourth sound where the intervals from the tonic are consonant The fourth note of the scale forms a dissonance with the tonic, but is consonant with the subminor second, sixth, and seventh, and with the major seventh

C (c)				Steps			Resultant Tones
^{7}D⌐	20	21	85	85			
^{7}E⌐	6	7	267	182	(9	10)	F_1, a
^{7}F	16	21	471	204	(8	9)	(E and 8 11)
^{7}G⌐	5	7	583	112	(15	16)	A⌐ e⌐
G	2	3	702	119	(14	15)	c
^{7}A♭	40	63	787	85	(20	21)	
^{7}B♭	4	7	969	182	(9	10)	g, C
B {	15	28	1081				
B {	8	15	1088	119	(14	15)	
C (c″)	1	2	1200	112	(15	16)	

Only one note B, is tempered, being raised 7 cents to make it a major third (4 5) above G, and 7 10, the inversion of 5 7, above ^{7}F The insertion of diatonic D and E allows septimal tetrads, as 4 5 6, 7 5, 6, 7, 8 , 5, 6, 7 9 , 5, 7, 10, 12, to be sounded

It is scarcely of use to try this scale on the pianoforte, but those who have the feeling for and a knowledge of septimal harmony will be able to appreciate its entrancing beauty

The further addition of diatonic A (3 5) completes a new, septimal, chromatic scale of twelve notes to the octave, with five grades of semitone at intervals of 85 119, 63, 119, 85, 112, 119, 85, 97, 85, 119 and 112 cents

I owe the appoggiatura of 85 cents to the interpretation of the enharmonic tetrachord of the Greeks offered by J A Serre, of Geneva, in 1752, and the step of 119 cents to B to William Chappell s " History of Music " 1874, p 220

W PERRETT

University of London University College,
Gower Street, London W C 1,
August 5

Crop-Production in India

IN the excellent review of Mr Howard's " Crop-Production in India " (NATURE, July 4, p 4) a rather important mis-statement occurs in respect to legislation, for the introduction of which my Committee was largely responsible May I explain at once that there is no law in British India prohibiting the sowing of any variety of cotton The reference is obviously to the Indian Cotton Transport Act of 1923, which enables a provincial Government with the consent of the local legislature, to notify for protection any specified cotton-growing zone A notification under the Act forbids the importation of cotton, cotton-seed, or seed-cotton into a protected area except under licence The object of such prohibition is to prevent

(*a*) The importation of inferior cotton for purposes of adulteration—an abuse which in the past, by spoiling the reputation of superior cottons had robbed the cotton-grower of the fruits of his enterprise , and

(*b*) To prevent the importation of inferior seed either as such or in unginned cotton

The Indian cultivator is not asked to submit to " drastic legislation of a type to which the free-born Western would probably never submit For the introduction of new varieties the Agricultural Departments depend on the merits of the new variety, on the organisation of the seed supply, and, most important of all, on thorough local demonstrations

B C BURT,
Secretary

Indian Central Cotton Committee,
Bombay,
July 31

[The legislation referred to justifies, I think, the use of the term " drastic " and I must adhere to the word , but, in view of possible misconception, I gladly withdraw the reference to the Occident in the phrase to which exception is taken —A B B]

Cultural Aspects in Geology[1]

By Prof. W. A. PARKS, University of Toronto.

THE science of geology is wide in scope and general in application; it deals with matter and with life, with time and with space; it touches the philosophical and borders on the romantic; majesty and beauty are its essentials, and imagination is necessary for its pursuit. The cultural value of such a science is not to be despised. It is my purpose to direct attention to well-known features of our science. I shall attempt to introduce no new facts, and I beg that you will consider my remarks merely as an attempt to lay emphasis on a selected few of the many great lessons of geology.

THE LAW OF TENDENCY TO THE COMPLEX.

To account for the existence of the human race and to determine the purpose, if there be a purpose, for its existence is probably the greatest and most fundamental problem with which humanity is confronted. An answer is not yet forthcoming, but it is interesting (and cultural) to inquire if the science of geology can throw any light on a problem so stupendous.

In the first place, it is to be noted that the earth is very old; its age is to be reckoned, not in millions, but in hundreds of millions of years. In the second place, living creatures have inhabited the globe, not from the beginning, but from the earliest period of which we have a definite record. Does not the inconceivably long duration of the earth itself and of life constitute a guarantee of a similar extension into the future? This assumption may not be in accord with rigid logic, but it falls within the scope of high probability. Further, geological history shows conclusively that some force or tendency has acted on the life principle to the production of higher and higher forms culminating in man. Is there any reason to assume that this long-enduring gradient should change its direction? I confidently believe that geological history teaches us that the earth, and life, and the upward tendency of life will all three reach out into the illimitable future.

The tendency towards the more complex (higher) seems to be a feature, not only of the organic, but also of the inorganic world. In the lower orders of life the tendency to the complex has acted throughout all the ages without the conscious volition of the individual. With the advent of the higher nervous complex that we call "reason" a new factor entered the field, a factor so important that many geologists now favour the establishment of a separate era, the "psychozoic," for the age of man. Undoubtedly the rise of mentality in the Pleistocene must be regarded as a geological event of profound importance. From the evolutionary point of view it may mark an event of comparable significance, in that it may be interpreted as a great saltation of the mental attributes without a corresponding physical development. The general tendency to the complex is not interrupted, but its manifestation is less material and more spiritual. It is a reasonable assumption that future evolution will be mental rather than physical, and that the long-continued upward gradient of complexity will not turn in its course.

I venture to state that the greatest lesson in geology is the tendency to the complex; if there be a purpose behind all things, the working-out of that purpose is herein revealed. It follows, therefore, that man can best fit into the scheme of things by facilitating the operation of a principle which has endured through all time and is to be regarded in the light of a revelation. The *duty* of man, if these premises be correct, is so to direct his efforts that his mental capacity may be strengthened and that a slightly better equipment may be transmitted to his offspring.

I would emphasise, also, the fact that all races of creatures and all individuals of a race do not evolve to higher forms. Similarly, it is not to be expected that all men are destined to give rise to higher types under the action of a beneficent, all-pervading principle.

The development of mentality in the human race has introduced new factors; perhaps it would be better to say it has strongly accentuated certain old factors. By reason of his superior mental equipment, man has acquired a degree of dominance never attained by any earlier race. Surely, his reason should temper his power, and he should realise the enormous responsibility that has fallen into his hands.

EVOLUTION.

Geological investigation has established, beyond all doubt, the basic facts that life has changed during the course of the ages, that this change has been uniform in direction over the whole globe, and that the general tendency has been towards greater complexity both in physical structure and in mental equipment. It has been established, further, that in certain instances, sequences are found indicating the gradual passage of one species into another. This observation is not necessarily a proof of descent, but it is a strong argument in its favour.

Life appeared on the globe in pre-Cambrian time; of its inception we shall probably never be able to obtain direct evidence. In course of time, however, recognisable protoplasmic units appeared—unicellular creatures neither plant nor animal. The second great event of life history occurred somewhat later in the pre-Cambrian—the separation of the parent stem into ancestral plants and ancestral animals. Here I would like to emphasise the fact that the difference between plants and animals lies, not only in the different nature of the metabolism, but also in the possession by the latter of a sensibility or mental equipment so vastly superior, that we are accustomed to think of it as absent in the vegetable world. In order to simplify our inquiry, let us confine the question to the animal stem, and let us imagine the primitive creature to be a generalised protozoan, as sooner or later it was. Within the pre-Cambrian occurred a third great organic event of tremendous significance—the Protozoa gave rise to the Metazoa. Having accomplished this feat, the ancestral Protozoa continued to reproduce their own kind. Despite differentiation, the making of genera and species, of offshoots that lived and offshoots that failed, the Protozoa during more than 500,000,000 years have never given rise to anything but unicellular offspring. The conclusion is obvious, that in the pre-Cambrian occurred

[1] From the presidential address delivered at Southampton on August 27 before Section C (Geology) of the British Association.

a marvellous event due to certain conditions which have never since been duplicated.

Similarly the primitive cœlenterate, presumably a sponge, gave rise to ancestral Cnidaria still within the pre-Cambrian. Never since has the sponge given rise to anything but the sponge, but the phylum has continued to exist and to differentiate within seemingly fixed bounds. Before the close of the pre-Cambrian all the phyla of Invertebrata arose successively in this manner. Possibly we may include the vertebrates, although they have not yet been found so far back in time. These are well-known principles, but reiterated here because I think that they are not always given their true value.

I would emphasise—the origin of phyla as great events in geological history, the crowding of these events into the pre-Cambrian, the continuation of ancestral stocks, and their failure ever again to give rise to new phyla. It would appear, further, that higher phyla have not developed through highly specialised genera of lower phyla. For the invertebrates this is evident in the appearances of all the phyla in the pre-Cambrian; for the vertebrates, in the first place nothing is known with certainty, and in the second place the various phyla appeared long before high specialisation was attained by the ancestral stock. Amphibia arose from primitive Devonian ganoids, not from highly specialised teleosts; reptiles were derived from early Permian stegocephalians, not from highly specialised Anura or Urodela. The eutherian mammals appeared with startling suddenness in the basal Eocene, and before the close of the period had developed into all the great classes.

Evolution in the phyletic sense is not a gradual process, not uniformitarian, but marked by great events in time. Specialisation and consequent fixation of characters are adverse to phyletic differentiation.

It is apparent that phyla can arise only through genera and species. How far the phyletic principles may apply in the lower taxonomic ranks is an interesting question, the consideration of which would unduly extend this address. I would venture to state, however, that close adaptation (high specialisation) is likewise inimical to the production of new genera and species. Further, I believe that close adaptation is the main cause of extinction.

Let us assume the existence of an organism *perfectly* adapted to its environment. Is it not a safe conclusion that *any* change in environment must result in the death of such organism? That there is now or that there ever has been a perfectly adapted animal is extremely doubtful, but all animals must be more or less adapted or they could not exist. It may be stated that *the margin between perfect and necessary adaptation* is the zone in which organic evolution is possible; further, that the nearer an animal approaches perfect adaptation, the more liable it is to extinction on the advent of changed conditions. This conclusion is in accord with the generally recognised fact that in many instances highly specialised animals have suffered sudden extinction; it is also in accord with the general observation that the geological record is one of extinction and replacement in so far as species and even higher taxonomic divisions are concerned.

The great weight of geological evidence points to the supplanting of one species by another, not to the transformation of species into their successors. A single transformation sequence may be regarded as sufficient to establish the principle, but an adequate explanation must be given of the failure of vertical seriations in the great majority of cases. This explanation is not yet forthcoming, and its lack stands as the chief item in the *contra* account of the balance sheet of evolution.

It is to the unfavourable changes that we must look for an explanation of the more deeply seated organic evolution, and by unfavourable I mean adverse to the present condition of the animal in that it is forced to further adaptation. A change of this kind is not of necessity *adverse to life*; it may even be stimulating. The animals towards the margins of a colony, by reason of their less perfect adaptation, may in a few instances survive an unfavourable change. The first impulse of these survivors will be to escape by flight, and thereby diminish the fatal suddenness of the change and thus achieve adaptation.

The new species would arise rather suddenly with but few individuals of the transition stages. Arrived at a favourable habitat, migration would cease, multiplication would ensue, and closer and closer adaptation would be achieved. Eventually an approximation to perfect adaptation would render the new species liable to extinction on the recurrence of unfavourable conditions.

This explanation of the common failure of vertical seriations emphasises migration as a factor in evolution and leads to the conclusion that transitional stages are few in number, scattered over wide geographical extents, and disposed in stratigraphically oblique lines. Barrell's "diastems," to be referred to later, support this explanation of abrupt changes in the faunas.

THE AGE OF THE EARTH

The mysteries of time and of space have long been subjects of profound contemplation and scientific inquiry; they are intimately connected with the destiny of man and bring him into touch with the infinite. High is the cultural value of the mere contemplation of infinity, and of supreme importance is any light that may be thrown on a problem long regarded as beyond human comprehension. In recent years the theory of relativity has opened to the mathematically trained mind a possible avenue to a solution, but to most geologists this avenue is a closed road.

The determination of the actual age of the earth has long engaged the attention of philosophers and scientists, and various widely divergent estimates have been made by approaching the subject from different points of view.

Kelvin, Tait, King, and other great physicists but a few years ago allowed the geologist a maximum of 40,000,000 years for the age of the earth. Recent studies on radioactive minerals have induced the same school to raise the figure to 1,710,000,000 years, a *volte face* that emphasises the danger incurred by "the dictatorial hierarchy of exact scientists" in raising a mathematical structure on an insecure foundation.

The chief methods of determining the age of the earth other than those based on radioactivity, are: the rate of decline of solar energy, the gradient of earth temperature, the quantity of salt in the seas, the rate of organic

differentiation, and the rate of denudation of lands and of accumulation in the seas in relation to the known thickness of strata made throughout the geological ages

The determination of age by means of radioactivity depends on the fact that uranium and thorium break down into lead and helium, and that the rate of this disintegration is known The time required for half a given amount of these elements to break down is known as the half-value period This period, according to Gleditsch, can be calculated to within 2 per cent, for radium it is 1660 years and for uranium 6×10^9 years An atom of uranium breaks down into one atom of lead and eight atoms of helium, if the content in these elements can be measured and compared with the quantity of unaltered uranium in an equal volume of the mineral, it is evident that the age of the mineral can be deduced

Lyell long ago demanded 240,000,000 years for organic differentiation, and Darwin thought 200,000,000 too short for the purpose On stratigraphic evidence, Barrell considered 250,000,000 a reasonable estimate for the duration of geological time since the pre-Cambrian

The history of the subject shows that high figures were originally proposed by geologists and that, later, they tried to lower their estimates under the influence of the shorter time allowed by the physicists More recently, the greater figures endorsed by the physicists permit the geologist ample time for his processes, both lines of inquiry are now pointing to the same result—higher and higher estimates of the immense antiquity of the globe

Intimately connected with the estimation of time are the rates of erosion of old rocks and of deposition of new Herein lies the most dependable geological means of determining the duration of the periods, nevertheless, there are serious difficulties to overcome, among which may be mentioned variations in the rate of decay under different conditions, variation in the rate of deposition and the occurrence of unrecorded intervals either evident or obscure

The rate of erosion has received much attention, but as this factor is obviously dependent on the shape and condition of the land surface, its average for all time is difficult to estimate Barrell considers that denudation by solution lowers the land surface one foot in 30,000 years, and that mechanical degradation accomplishes this result in 13,800 years The two forces acting together require 9000 years to effect one foot of erosion

Barrell's estimate of 250,000,000 years since the beginning of the Palæozoic was arrived at by a study of details of deposition under the hypothesis of rhythms in geological time According to this author, time is to be measured by rhythms or pulsations, the greater rhythms having shorter rhythms imposed upon them The longer are to be measured in terms of the smaller, and the smaller in terms of years A single rhythm is an erosion cycle and small partial rhythms are superimposed on it Present erosion and sedimentation owing to the Pliocene-Pleistocene uplift is unduly high, with the result that estimates of time based on the present rate of erosion are much too short Barrell would further increase the time by restricting the area of deposition to the zone immediately below the local base level, and making the accumulation dependent on upward oscillations of the base level or downward oscillations of the bottom

In connexion with the rate of sedimentation and its bearing on the age of the earth, it is apparent that the intimate structure of the stratified rocks must be looked to for data bearing on the problem To this end the character and mode of formation of these rocks are now receiving an increasing degree of attention A better understanding of sedimentation is being obtained by direct observation on the formation of modern sediments, determination of the precipitating value of algæ and bacteria, studies on coral reefs, deep-sea investigations, studies on colloidal solutions, investigations of chemical deposits, and a better appreciation of the value of facies and vegetal terrestrial deposits Direct investigation of the rocks themselves is leading to an increased use of the petrographic microscope and of analytical methods Secondary features of stratified rocks are receiving greater attention, horizontal transitional stages are better understood, and the relationship of strata to sea invasions has led to a fuller appreciation of the value of palæogeography

The Origin and Interior of the Earth

The question of the earth's origin is evidently closely related to the problem of its age Although geologists are inclined to disclaim this aspect of the subject, I feel that it cannot be disregarded under the title of this address The interior of the earth is beyond direct observation, the deepest mines and bore-holes scarcely penetrate the outermost skin Certain fundamental facts, however, may be taken as established The interior is hot, rigid, and heavy (sp gr 5 6 as compared with 2 7 for the known exterior), the accessible exterior is composed of elements common to the universe Beyond this all is vague and speculative

It is worthy of particular emphasis, however, that while the earth as a whole acts as an almost perfectly rigid body, the external envelope with which we are familiar is by no means rigid Adjustments have taken place throughout all geological time, and I need not quote evidence that they are still taking place The acquisition of perfect rigidity by the globe is to be regarded as a tremendous calamity This condition attained, the universal deluge is within sight geologically speaking, and the end of the present order of things must inevitably ensue Earthquakes, therefore, are not to be regarded as unmixed calamities, they are evidence that the fatal total rigidity has not yet been attained

It might be asked if there is any evidence in geological history of an approach to a condition of total rigidity or of a tendency in this direction There can be little doubt that pre-Cambrian events were on a scale seldom, if ever, attained in later time Cambrian and Ordovician transgressions of the sea were also on a grand scale, but later movements, on the whole, seem to have been smaller and more local in their expression, although there were notable exceptions as the Tethys sea in Europe, the great invasion of the Coloradoan geosyncline in Upper Cretaceous time in North America, the tremendous volcanic activity of the Miocene, and the grand epoch of mountain-building in the Pliocene and Pleistocene

The general conclusions seem to be that the earth is not showing a trend towards rigidity, but that earth movements and vulcanism are becoming less profound in scope and less widespread geographically, the average of activity being maintained by more frequent recurrence

Earth Movements and Adjustment

The causes of earth crumpling and the dynamic laws which govern the phenomena are subjects well within my theme, but their consideration would lead me to undue length Earth movements, of necessity, are bound up with theoretical considerations of the earth's interior Whether earth crumpling is due to loss of terrestrial heat and consequent contraction of the nucleus, or whether the modern concept of isostasy offers a better explanation, there must be a downward limit to terrestrial disturbances This limit has been placed at 113 7 kilometres and termed the "depth of compensation"

It is obvious that a consideration of this subject would lead to a discussion of land forms and their influence on human activities—definition of nationality, physiographic control, distribution of faunas, and countless other effects, all of which extend beyond the realm of technical geology and form part of a general education if they are not "cultural" in the narrower sense There is, however, one great lesson to be derived from the study of earth movements that bears on the general scheme of things and is worthy of especial mention—the marvellous continuity of conditions

The diameter of the earth is about 8000 miles and the maximum of relief of the lithosphere about eleven miles, approximately 0 14 per cent Oceanic waters have filled the depressions and continental masses have risen above the water-level—a condition that has maintained throughout all time in the opinion of most geologists The present area of the land is 27 7 per cent of the whole terrestrial surface, and the average height above sea-level of the continental masses is only 2120 feet according to de Lapparent It is apparent that the actual volume of that part of the lithosphere which projects above sea-level is extremely small when compared with the volume of the whole globe

It is well known that the power of erosion is sufficiently great to have reduced this relatively small mass to sea-level time and time again throughout the long course of the geological ages Nevertheless, it is confidently believed that this result has never been entirely achieved Rejuvenation has kept pace with erosion throughout the hundreds of millions of years that the earth has endured In my opinion this marvellous nicety of adjustment between two great sets of opposing forces is one of the major lessons of geology Is it a mere coincidence or is it evidence of design?

Climate

Climatic change must be regarded as an ever-present factor It is highly probable that variation in climate will greatly affect the activities of the human race within a measurable number of years, and it is not impossible that the sites of our present centres of civilisation will be buried under glaciers and that a new civilisation will occupy, under a genial climate, the present inhospitable regions around the poles

Despite the changes in any given locality, the continued existence of life is sufficient evidence that the whole globe has not experienced, from the earliest geological time, any very great universal change in climate Gruner has proved to the satisfaction of most geologists the existence of algæ in the Keewatin of Minnesota The great masses of limestone with disseminated graphite of the Grenville are at least suggestive of life, and Moore has brought forward convincing evidence of algæ in the Animikie of Belcher Islands in Hudson Bay Both the Archæozoic and the Proterozoic, therefore, were warm enough to permit organisms to exist despite the intervening event of an ice age in the Huronian

Wonderful have been the changes in climate and far-reaching their effects, but truly marvellous has been the continuity of a range of temperature permitting the existence of life from the very dawn of earth history to the present moment Nothing short of a cosmical catastrophe can alter a condition that has maintained for nearly two thousand millions of years Surely if culture is the cultivation of the spirit, the contemplation of geological climate should lift the mind above the mere material into the realm of the philosophical and the spiritual If the continuity of the observed range of temperature is due to a single factor—solar energy—the endurance of that energy is a marvellous thing If the observed climatic continuity is a composite result due to various sources of energy, it is still more marvellous

The Study of Geology

Whatever satisfaction is to be derived from the acquisition of knowledge, there is always a discouraging factor in the realisation of our limitations Owing to the complex nature of the subject and the vast number of facts involved, the study of geology is peculiarly effective in this respect, and cannot but tend to a humble attitude of mind Another potent influence to this end is the realisation of the mistakes that have been made, even in the basic principles of the science From the fantastic theories of the cosmogonists arose eventually the doctrine of catastrophism, this conception yielded to uniformitarianism, and to uniformitarianism was added the doctrine of evolution Le Conte described Darwin as a uniformitarian evolutionist To-day uniformitarianism is being questioned seriously from both the inorganic and the organic points of view We are swinging back to a conception of a milder catastrophism variously expressed as rhythm, diastrophism, and so on The necessity of drawing conclusions from doubtful or insufficient evidence is an ever-present antidote for dogmatism Many of our conclusions are merely inferences subject to revision in the light of further evidence

To humbleness and caution I would add a conviction of theism as a result of the study of geology I fear to venture on dangerous ground, but I must be allowed the opinion that materialism offers no adequate explanation of the wonders of geology With revealed religion I am not here concerned, but I believe that the inconceivably long gradient that has led ever upward to the mentality of man has not been traced without design, and I see no reason why that gradient should terminate I look, rather, to its upward continuation to even greater heights beyond

Some Issues in the Theory of "g" (including the Law of Diminishing Returns)[1]

By Prof C SPEARMAN, F R S

THEORY OF "G"

THE following communication treats of certain points in a theory which has become known as that of Two Factors or of *g* At the present time this theory has undergone very elaborate development The mental testing from which it originated lay at first as a foreign intruder in the midst of general psychology Its opponents—and these were not few—regarded it as an excrescence that should be forthwith cast out, and even its best friends wondered how the general psychology was ever going to assimilate it But, seemingly neither of these solutions is happening to any great extent The mental testing has waxed larger and established itself more firmly than ever *without* much assimilation with the current general doctrines, indeed, it seems more likely, cuckoo-wise, to eject *them* from the psychological nest In particular, the theory of *g*, which arose from the mental tests, has now managed to spread itself over the whole of the cognitive side of psychology, and not impossibly it will soon extend its scope over into the supplementary or conative side

For the present I do not propose to depict the whole elaborate theory of *g* even in outline Such an attempt is reserved for a work that will appear shortly But a very few words may be allowed here to indicate its essential foundation as unwaveringly preserved from the very beginning This consists in the theorem, that the measure of *every different ability of any person can be resolved into two factors, of which the one is always the same, but the other always independent* Suppose, for example, that any person undergoes a mental test and obtains seventeen marks for it The theory asserts that this can actually be divided into two parts, say eleven and six, such that (on reduction to comparable units) the eleven re-occurs for this person in every other test however widely different, whereas the six is each time replaced by some other number independently

The establishment of this doctrine falls into three distinct phases The first is to ascertain what are the conditions under which the measures of any ability admit of such division into two factors We may note that this phase has often been erroneously called an assumption or hypothesis It is really nothing of the kind, but simply a mathematical demonstration Given the said conditions, then the divisibility into such two factors must necessarily occur, just as, given that a triangle has all its angles equal, then it must needs also have all its sides equal The second phase is to find out where, if at all, the conditions are actually fulfilled Again, no assumption or hypothesis of any kind is involved, the matter is nothing more than observation of fact

Then comes the third and last phase, that of supplying the factors with some plausible interpretation Here the most cautious procedure, and one that goes not an inch beyond what has really been proven, is simply to denote these factors by the non-committal letters *g* and *s* respectively Any interpretation going beyond this can only, in our present state of knowledge, have a provisional value, it can serve to inspire further investigation, by which it will assuredly suffer much modification itself With this reservation, then, the hypothesis at present seeming most helpful and suggestive is that the *g* measures something of the nature of an "energy" derived from the whole cortex or wider area of the brain Correspondingly, the *s*'s measure the respective efficiencies of the different parts of the brain in which this energy can be concentrated, they are, so to speak, its "engines" Whenever the mind turns from one operation to another, the energy is switched off from one engine to another, much as the power supply of a factory can be directed, at one moment to turning a wheel, at the next to heating a furnace, and then to blowing a whistle

RECENT CONFIRMATION

So much to serve as a general description of the doctrine I will now bring to your notice some recent work whereby its foundations have received additional strengthening, both on the side of mathematics and on that of actual observation

To take the former first, the earlier researches had only shown what conditions are *necessary* for the divisibility into the two factors Later investigation has proved that these conditions are also *sufficient* In other words, we now know, not only that under the said conditions the divisibility into two factors may possibly occur, but also that it inevitably must do so I stress this point because some of the recent writing on the subject appears to make the contrary and mistaken statement that, even when the conditions are satisfied, still the divisibility either may or may not ensue

As to the precise nature of these conditions, they are based upon the coefficients of correlation Such coefficients, as is now generally understood, consist in numbers that indicate just how closely any two abilities or other characters tend to vary in proportion to one another They are usually symbolised by the letter r Thus, r_{12} would denote the degree that any ability 1 tended to vary from individual to individual proportionately to some other ability 2 Now, the conditions for the divisibility into the two factors reduce themselves to the simple equation

$$r_{12}\ r_{34} - r_{13}\ r_{24} = 0$$

Here the value on the left is called the tetrad-difference When such tetrad-differences remain equal to zero throughout any set of abilities, whichever of them may be taken as 1, 2, 3, and 4 respectively, then, and then only, each of these abilities can be divided up into two factors such as we have described Should any one ask *why* this particular equation should have the virtue of necessitating such a divisibility, I can only answer that it is but one out of all the miracles of mathematics I never cease to be astonished at it myself For further elucidation, reference must be made to the mathematical proof (Proc Roy Soc, 1923)

So far we remain in comparatively smooth waters The chief difficulty arises when we turn to what are known as the errors of sampling Suppose you wanted to know whether a field of potatoes was bearing a good crop You walk about, pulling up a plant here and

[1] Presidential address delivered at Southampton on August 27 before Section J (Psychology) of the British Association

there. This gives you some approximate knowledge, but not an exact one. For all you can tell, you may have been exceptionally lucky or unlucky in your selection. The degree of discrepancy between the average size of the potatoes actually pulled and that of the whole field is your error of sampling. Now, just the same befalls any coefficient of correlation between two abilities. You want to know how closely these two go together with people of some general class. You pick out, say, 100 of these people; but just in this 100 the correspondence between the two abilities may happen to be rather higher or lower than on an average throughout the entire class. Your coefficient of correlation will have an error of sampling; and our preceding tetrad-difference, being made up of correlational coefficients, will have one also.

Now, the latest advance in the theory of *g* consists in showing the general magnitude of the tetrad-differences that will arise from the sampling errors alone, even when the true magnitude is always zero. This value of the tetrad-differences to be expected merely from sampling was published last year (*Brit. J. Psychol.*).

Having got this theoretical value, there remains the momentous step of comparing it with the median value which is actually observed. The theory of *g* stands or falls according as these two values are or are not found to agree.

This step so fraught with fate has now been taken. To avoid all danger of personal bias, no work of my own was chosen for this crucial decision, but that of an investigator who, more than all others, had shown himself unsympathetic with the doctrine of *g*. Here is his table of correlations as published by himself.

	Test	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Completion		98	94	79	62	91	71	54	78	88	55	42	33	25
2	Hard Opposites	98		84	80	64	81	79	70	73	74	52	43	26	25
3	Memory words	94	84		62	55	82	49	56	73	71	53	40	28	21
4	Easy Opposites	79	80	62		57	5-	68	53	42	56	45	29	38	48
5	A Test	62	64	55	57		55	54	73	39	51	39	59	25	22
6	Memory pass	91	81	82	52	55		53	57	59	66	54	31	28	19
7	Adding	71	79	49	68	54	53		45	39	47	51	57	17	25
8	Geomet. forms	54	70	56	53	73	57	45		35	49	34	56	25	25
9	Learn. pairs	78	73	73	42	39	59	39	35		69	36	29	26	09
10	Recog. forms	88	74	71	56	51	66	47	49	69		44	37	34	28
11	Scroll	55	52	53	45	39	54	51	34	36	44		31	19	27
12	Compl. words	42	43	40	29	59	31	57	56	29	37	31		21	07
13	Estimat. length	33	26	28	38	25	28	17	25	26	34	19	21		24
14	Drawing length	25	25	21	48	22	19	25	25	09	28	27	07	24	

To work out all the tetrad-differences was no light undertaking, since they run to the number of 3003. The calculation of these was entrusted to the competent hands of Mr. Raper. When all was reported ready we met, I carrying the "probable error" of the tetrad-differences—that is, the median value that should by theory be expected to arise from sampling alone; he bringing the average value of the 3003 tetrad-differences actually derived from the above table. My number was 0·061. His was 0·074; this, in order to get from the average to the median, had to be multiplied by the well-known constant 0·845, whereby it came finally to 0·062.

It may be of interest to survey the entire frequency distribution of the values concerned. The dotted curve (Fig. 1) shows the relative frequencies that should be expected from the sampling errors alone. About half should lie between *a* and *b*; extremely few beyond *c* or *d*. The continuous rectangles show the relative frequencies that actually occurred. A better agreement of a theoretical frequency curve with one of actual observations does not, I venture to say, exist throughout psychology, or perhaps even throughout statistics.

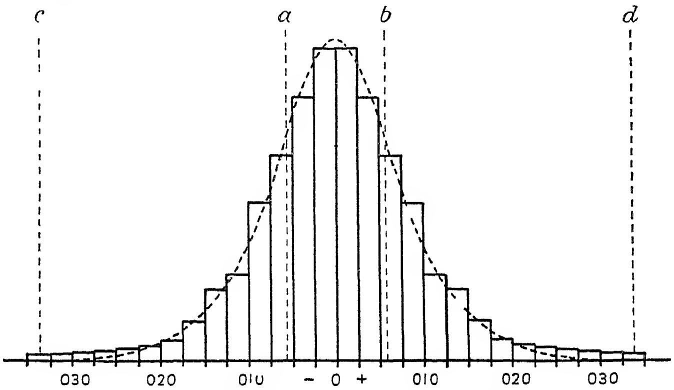


FIG. 1.—Tetrad differences of Simpson (37 subjects).

The preceding result may be instructively compared with another one. The doctrine of Two Factors, as is only proper, has had to make its way in the face of strong resistance. But the latter has curiously adopted two contrary lines of defence. One is to question whether the mathematical criterion would really be satisfied by actual observation; and this doubt, I hope, has been met by the facts just cited. But the other opposition has instead asserted that *any* ordinary table of positive correlations would naturally satisfy it, so that such satisfaction must be devoid of peculiar significance. Recently this second line of opposition has acquired much greater vitality, in that a table of correlations has now been brought forward as an actual example; it is not derived from mental but from physical traits, and yet, it is said, exhibits a quite similar character. Here is the table.

		1	2	3	4	5	6	7	8
1	Area of ossification		88	60	62	43	31	25	26
2	Ratio of ossification	88		52	58	41	21	24	29
3	Height	60	52		69	44	51	45	11
4	Weight	62	58	69		65	39	40	83
5	Chest girth	43	41	44	65		59	36	69
6	Lung capacity	31	21	51	39	59		46	26
7	Strength of grip	25	24	45	40	36	46		14
8	Nutrition	26	29	11	83	69	26	14	

Let us, then, look at the median tetrad-difference derived from this table and compare it with the probable error to be expected from sampling alone; the respective values are 0·089 and 0·011; that is to say, the actually observed value is no less than eight times greater than what theory demands. Here again we can examine the whole frequency distribution.

The explanation of the figure (Fig. 2) is the same as in the preceding case of Simpson (Fig. 1). Between the curve showing the values to be expected from the errors of sampling and the rectangles showing those actually observed there is this time no agreement whatever.

LAW OF DIMINISHING RETURNS

So much for the strengthening of the doctrine. I will now proceed to describe a rather curious matter that has arisen in the course of its elaboration.

Since the very beginning it has been known that the two factors, *g* and *s*, the energy and the engines, may have widely different relative importance, according to the particular mental operation involved With some operations the superiority of one person over another is preponderantly decided by their respective amounts of the energy With other operations, on the contrary, the dominant factor is the engine

Subsequent research, moreover, has been gradually outlining the cases which incline in one or the other direction Thus the energy is in general more important for operations that are composite, the engines for those that are monotonous This is natural enough The composite operation really involves several different engines ; the superiority that an individual may happen to have in any one of them will tend to be neutralised in the average of them all ; but a superiority in the energy will make itself felt in each, and thus obtain cumulative influence Again, the energy is less and the engine more influential whenever the operation depends much upon the efficiency of some sensory or motor apparatus This, too, is natural enough ; for such apparatus obviously constitutes a part and parcel of the engine Yet again the energy has been found to lose in importance as compared with the engine in proportion as the operation tends less to create new mental content and more to reproduce old

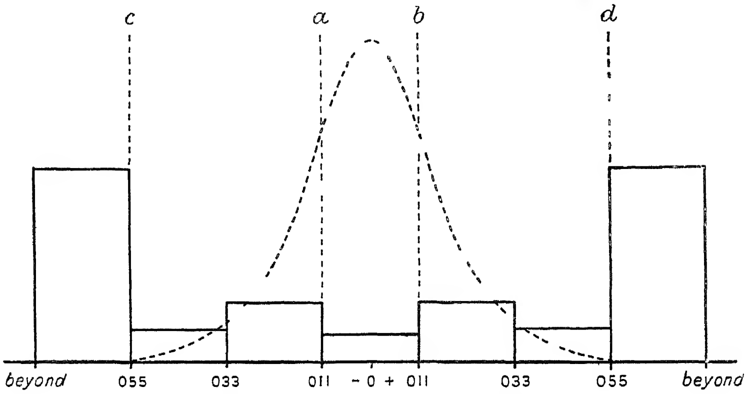


FIG 2 —Tetrad differences of A Gates (115 subjects)

The point which I wish to bring forward in this place is that the relative influence of the energy and the engines changes largely with the class of person at issue The most drastic example of this is supplied by a comparison between normal children and those who are mentally defective The work of Abelson may be quoted, where the same tests were applied by the same experimenter to both classes The correlations obtained for the two respectively are as follows

NORMAL CHILDREN (78 CASES)

	1	2	3	4	5	6	7	8	9	10	11	12
1 Opposites		75	78	71	62	64	72	78	57	40	46	33
2 Observation	75		72	58	60	58	67	56	58	56	52	29
3 Absurdities	78	72		53	41	44	79	68	41	46	34	29
4 Memory sentences	71	58	53		54	61	54	37	54	55	19	43
5 Crossing o's	62	60	41	54		73	48	54	38	36	52	35
6 Geometrical figs	64	58	44	61	73		45	48	30	42	48	35
7 Discrim length	72	67	79	54	48	45		56	49	30	31	06
8 Crossing patterns	78	56	68	37	54	48	56		30	21	27	18
9 Memory form	57	58	41	54	38	30	49	30		24	31	29
10 Tapping	40	56	46	55	36	42	30	21	24		29	18
11 Strength of grip	46	52	34	19	52	48	31	27	31	29		28
12 Interpret pictures	33	29	29	43	35	35	06	18	29	18	28	

Mean=0 466

DEFECTIVE CHILDREN (22 CASES)

	1	2	3	4	5	6	7	8	9	10	11	12
1 Absurdities		1 0	1 0	98	97	1 0	1 0	1 0	98	94	94	79
2 Opposites	1 0		97	95	87	91	85	76	85	87	70	72
3 Crossing patterns	1 0	97		91	80	88	68	92	74	78	76	67
4 Crossing o s	98	95	91		85	77	84	67	76	81	73	55
5 Memory sentences	97	87	80	85		73	90	68	88	65	78	68
6 Observation	1 0	91	88	77	73		76	83	71	86	59	65
7 Memory form	1 0	85	68	84	90	76		65	67	70	77	75
8 Interpret pictures	1 0	76	92	67	68	83	65		74	80	80	59
9 Geometrical figs	98	85	74	76	88	71	67	74		65	60	62
10 Discrim length	94	87	78	81	65	86	70	80	65		51	45
11 Tapping	94	70	76	73	78	59	77	80	60	51		61
12 Strength of grip	79	72	67	55	68	65	75	59	62	45	61	

Mean=0 782

All round, obviously, the correlations are much smaller in the case of the normal children This indicates that with these the influence of the energy has gone down and that of the engines has correspondingly gone up

Compare next young children with those that are older Here I may quote from the admirable work of Prof Burt Applying his test of reasoning to numerous children of different ages, he obtained the following correlations with the estimates of the teachers (in general, the older children show smaller correlations)

Ages	10 11	11 12	12 13	13 14
Correlations	78	81	64	59

No less marked is this tendency on comparing children with adults As examples may be taken the correlations obtained by Otis and Carothers respectively for what appear to have been similar tests in each case

Test	Correlations with *g* Otis, grades IV VIII	Carothers students
Analogies	0 84	0 71
Completion	0 88	0 53
Directions	0 86	0 45
Digits, memory	0 41	0 22

Now these changes obviously follow a general rule The correlations always become smaller — showing the influence of *g* to grow less—in just the classes of person which, on the whole, possess this *g* more abundantly The rule is, then, that the more energy available already, the less advantage accrues from further increments of it This is a well-known property of engines in general Suppose that a ship at moderate expenditure of coal goes 15 knots an hour By additional coal the rate can readily be increased another 5 knots By doubling the addition of coal, however, the additional knots will certainly not be anything like doubled This relation is observed not only in engines, but also widely elsewhere In the science of economics, for example, it is expressed in the well-known law of diminishing returns A moderate amount of capital spent on a given piece of land will produce a certain return ; but on adding further doses of capital the returns will not increase proportionately

In our psychological case of different classes of persons there enter no doubt various complications which render the theoretical interpretation more dubious Above all, there is the fact that the classes better endowed with *g* have usually undergone more or less selection For example, the university students of Carothers had been cleared of the weaklings who could not matriculate This in itself would tend to lower all correlations due to *g* However, such facts would seem capable of accounting for only part of the phenomenon,

not for the whole There remains enough over to suggest a genuine law of diminishing returns for mental as for material processes

Corollary of Independence

The next and final point to be raised here is a corollary of what has been said Since a great many abilities depend almost entirely upon the efficiency of the engines involved and this efficiency varies independently from individual to individual, we may conclude that these abilities themselves vary almost independently from individual to individual

This theorem has, indeed, been called into question Some authorities have asserted the existence of a general "sensory level" of ability, so that the persons who are successful at one kind of sensory performance will tend to be so at others also Other writers have adopted a similar position as regards what they call "practical" ability, persons are taken to be either endowed or not endowed with this all round But no such position would appear to be supported by the available definite evidence Dr McCrae, for example, has recently examined the correlations between different tests that have been entitled those of "performance" These, even among persons of comparatively low status, proved to be, in fact, almost independent of each other Still more striking has been the result of a very valuable investigation by Mr Philpott He undertook to test the discrimination of length, a power which obviously possesses great importance in many spheres of industry He wisely tested this discrimination in two different ways First, he showed pairs of lines and made the subjects judge which was the longer, and then he gave them single lines and made them, in each case, draw another line as nearly as possible of the same length As result, these two performances, that seemingly are but manifestations of one and the same power, turned out to be almost entirely independent Those who were best at judging between the two lines already drawn did not, to any appreciable extent, excel at making a second line equal to a given one Quite similar results were obtained for the discrimination of angles, as also for perceiving whether a line is straight or not

Accepting, then, the conclusion that an immense number of abilities vary from one individual to another almost independently of each other, what is the practical result? Let us try to get a notion how such abilities of any person must be distributed in respect of excellence By all experience, and also by statistical theory into which we cannot enter here, the great bulk of his abilities will tend to be mediocre, that is to say, they will be near the general average of his class A fair number will be distinctly above this average, and a fair number below A small number will be much above and so also below The whole frequency distribution will, in fact, have a bell-like shape similar to that which was shown by the curves of the tetrad-differences to be expected from sampling errors At the extreme ends of the distribution will lie a very small number of performances for which the person is, on one side a genius, and on the other an idiot Every normal man, woman, and child is, then, a genius at something as well as an idiot at something

It remains to discover *what*—at any rate in respect of the genius This must be a most difficult matter, owing to the very fact that it occurs in only a minute proportion out of all possible abilities It certainly cannot be detected by any of the testing procedures at present in current usage, but these procedures are capable, I believe, of vast improvement

The preceding considerations have often appealed to me on looking at a procession of the unemployed, and hearing some one whisper that they are mostly the unemployable That they are so actually I cannot help concurring But need they be so necessarily? Remember that every one of these, too, is a genius at something—if we could only discover what I cherish no illusion, indeed, that among them may be marching some "mute inglorious Milton, some Cromwell guiltless of his country's blood" For these are walks in life that appear to involve a large amount of *g* But I am quite confident that every one of them could do something that would make him a treasure in some great industrial concern, and I see no reason why some should not have even become famous, in such occupations, for example, as those of dancers, jockeys, or players of popular games

Radiometric Measurements of Stellar and Planetary Temperatures

By Dr W W Coblentz, Bureau of Standards, Washington, D C

THE recent measurements of planetary radiation and planetary temperatures, especially of Mars, had their beginning in the first really successful tests at the Lick Observatory, Mt Hamilton, California, in July 1914, when thermo-couple measurements were made on 112 celestial objects, including 105 stars, down to magnitude 6 7, and the planets Venus, Mars, Jupiter, and Saturn (Bureau of Standards Sci Paper, § 244, 1914) The experimental procedure then employed, and the results obtained, have foreshadowed, in an unforeseen manner, practically everything that has been accomplished since then

During the world strife and confusion that occurred in the meantime, nothing further was accomplished until the fall of 1921, when, at the invitation of the Lowell Observatory, I was given a further opportunity to try out a new method of measuring stellar temperatures by means of screens of quartz, water, etc, which separated the incident radiation into components containing radiation of the following wave-lengths 0 3 to 0 43 μ, 0 43 to 0 6 μ, 0 6 to 1 4 μ, 1 4 to 4 1 μ, and 4 1 to 12 μ In this manner the distribution of energy in the spectra of 16 stars was determined, thereby obtaining for the first time an insight into the radiation intensities in the complete spectrum of a star

From a comparison of the observed stellar spectral radiation components with similar data, calculated for a black body at various temperatures, it was found that the stellar temperatures range from 2500° to 3200° K for red stars, up to 14,000° K or even higher for blue stars, which is in good agreement with other methods of estimating stellar temperatures

Since then Pettit and Nicholson, using similar thermocouples and a transmission screen of water attached to

the great 100-inch reflector of the Mt Wilson Observatory, have been able to study long period variable stars of visual magnitude down to magnitude 9 2 and temperatures below 2000° K In the meantime, Abbot has succeeded in measuring the distribution of energy in the spectrum of a number of the brightest stars, and has obtained temperatures in good agreement with those previously observed by the writer, using a thermocouple and transmission screens Furthermore, using the writer's radiometric measurements, and assuming that the radiation from these stars is similar to that of a black body, Stetson has computed stellar diameters which are in good agreement with those measured directly with an interferometer

From the foregoing results it appears that the outlook for the thermocouple as a useful instrument in stellar radiometry is very promising (1) as a device for estimating stellar diameters, and (2) for determining the temperature of stars that are too small to measure the spectral energy distribution directly, thus supplementing the work of Abbot The only discrepancy is perhaps in the published measurements of the radiation from Sirius There seems to be something elusive about this star Back in 1914 it was on the list for measurement, but because of daylight and low altitude no attempt was made to measure it In 1921 a series of radiometric measurements gave a water-cell transmission of about 70 per cent (in Bur Stds Sci Paper, § 438, is given the uncorrected value, 65 per cent) This would indicate that the spectral type of the companion star of Sirius is lower than A—perhaps below type F or down to type K Owing to an uncertainty in some recent radiometric measurements on this star, further work must be undertaken to disprove or verify these results

The results of 1921 were so promising that the Lowell Observatory extended the invitation to continue the investigation in 1922, especially of planetary temperatures, in preparation for the opposition of Mars in 1924

In all these measurements of planetary radiation, use was made of the 40-inch Lowell reflector with focal lengths of 220 inches and 640 inches, Mr C O Lampland, astronomer at the Lowell Observatory, collaborating The measurements of 1922 and of 1924 are in agreement in showing that the planetary radiation emanating from Jupiter and from Saturn, and transmitted by our atmosphere, is very small, while the planetary radiation from Venus, Mars, and the moon is, relatively, very intense The radiometric measurements made in 1922 indicated that about 30 per cent of the total radiation emanating from Mars is of planetary origin, as compared with 80 per cent from the moon From the fact that the surface temperature of the moon is estimated to be considerably above 100° C, the writer estimated (Bur Stds Sci Paper, § 460, 1922) that the temperature rise of the surface of Mars is considerable—perhaps so high as 10° to 20° C

From the water-cell transmissions obtained by us in 1922, Menzel (*Astrophys Jour*, 58, p 65, 1923), using Russell's formula, calculated the following temperatures Venus, 50° C, Jupiter and Saturn, − 110° C, and the moon, 120° C From the water-cell transmissions of the radiation from Mars, observed on June 15 and 18 1922, his calculations gave temperatures of − 5° C and − 9° C respectively, the higher value being for the smaller receiver, which intercepted 0 4 of the diameter of the planetary disk From the large temperature gradient observed in 1924, extending from the equator to the poles and the limbs of the planet, it is evident that the highest temperature, − 5° C, is an average value, which should be corrected for latitude This would raise Menzel's values to 5° C, or perhaps even higher, when corrected for non-black body radiation

Using our data observed in 1924, Menzel has calculated an average temperature of − 30° C for the whole disk of Mars The temperatures of the apparent centre of the disk ranged from − 5° C on the bright areas to 22° C on the adjacent dark areas, the predominating values being 6° to 9° C The true temperatures would be about 10° higher, or 15° to 20° C The temperatures derived by this method of reducing the data are in good agreement with those obtained by three other methods, all of which indicate conclusively that the equatorial temperature of Mars, at perihelion, was considerably above 0° C

The planet Venus is one of the most interesting cases met with in radiometric observations The surface of the planet is hidden by clouds, and its period of rotation is undetermined Hence the thermocouple radiometer appears to be a means of obtaining further information on this question For it was found that not only does the illuminated crescent show the presence of considerable planetary radiation, but the unilluminated part of the disk also emits a large amount of infra-red rays This raises the question whether the radiation from the dark side of the planet is owing to a rapid rotation If the period of rotation is long (225 days), then it seems necessary to assume that the surface of Venus is still quite warm, although the highly selective condition of the planetary radiation at 8-12 μ may perhaps be interpreted as due to radiation of the hot gases convected from the illuminated over the dark part of the planetary surface However, since this involves distances of 800 to 1000 miles over the surface, it seems difficult to reconcile this assumption with the radiative properties of the gases which probably constitute the atmosphere of Venus

An interesting and important observation is that the intensity of the radiation emitted from near the south cusp in the present position of the planet Venus—both for the dark and the illuminated regions—is greater than that emanating from corresponding points near the north cusp This may be owing to differences in the surface conditions, as previously observed on Mars Then, again, it suggests an effect of insolation due to inclination of the axis of rotation, analogous to seasonal changes on Mars and the earth Further radiometric observations, at different presentations of the planet's surface to the earth, will be required to test this question If this is seasonal, then it should be possible to establish the position of the axes of rotation of Venus

From our data observed in 1924, Menzel calculated the following temperatures Venus, 60° C, Jupiter, − 135° C, Saturn, − 150° C, Uranus, lower than − 185° C, and the moon, 125° C These calculations are in good agreement with those based upon our data of 1922, and they are in good agreement with Christiansen's theoretical calculations made long ago, in which he obtained the following values Venus, 65° C, Jupiter, − 147° C,

Saturn, $-180°$ C. Uranus, $-207°$ C., and Neptune, $-221°$ C.

In the case of Saturn, the observations seem to indicate that the temperature is higher than can be maintained solely by the incident solar radiation. In other words, the interior of the ball of Saturn is still relatively hot. This is in agreement with the views expressed by Poynting twenty years ago, when he made his theoretical calculations of planetary temperatures, obtaining 69° C. for Venus and $-38°$ C. for Mars. As an average value for the whole disk of Mars, Poynting's calculation of $-38°$ C. is in good agreement with our observed value of $-30°$ C.

The observed temperature of the moon, 125° C., is in good agreement with the values assigned to it years ago by Lord Rosse, 110° C., and more recently by Very, 150° C., by comparison of the lunar radiation against a black body.

Deinosaur Eggs

By Dr. F. A. BATHER, F.R.S.

THE *Times* published on September 9 an interesting despatch from its Peking correspondent, giving further details of the discoveries in Mongolia by the expedition from the American Museum of Natural History, led by Mr. Roy C. Andrews. The fresh information about the fossil eggs attributed to deinosaurs suggests some comment.

Two of the recent finds are particularly worthy of note. One is a nest of twelve eggs almost perfectly preserved. The eggs were arranged in a circle, with the narrow ends pointing outwards; no doubt the broad end was, as in birds, that which first emerged, but in birds' nests this end of the egg is, as one would expect, directed outwards. Then the eggs are said to have been "in two layers of six each," those of the upper layer presumably alternating with those of the under one. This, if a correct description, suggests that the deinosaur scooped a basin in the sand, and perhaps covered the first layer with sand, as is the habit of the Nile crocodile.

The other find was a nest of five eggs, "smaller than those found two years ago, more elongated, and evidently the produce of another type of dinosaur. The shells are smooth, in contrast to the dimpled surface of the others, and very thin." Are they the eggs of a deinosaur at all? All as yet known have notably thick shells. These might be the eggs of a crocodile or a chelonian. Turtles' eggs are now being fossilised in just the same way in the sand-dunes of Western Australia.

The last question will have to be settled by the study of thin sections. It is strange how little was known two years ago about the structure of egg-shells, whether recent or fossil, of birds or of reptiles. Nathusius alone has studied thin sections of recent egg-shells, describing that of the moa in 1870, and that of a python in 1883. About 1870 also, some Cretaceous fresh-water sandstones in Provence yielded the bones of a reptile and some fragments of egg-shell. The latter and thin sections cut from them were re-studied in 1922 by Dr. Van Straelen and Mr. E. Deneyer of Brussels. The reptile is generally supposed to be some sort of deinosaur, and the eggs are assigned to it with some probability, made stronger by Dr. Van Straelen's later researches, of which a preliminary account was recently issued by the American Museum of Natural History. The following summary is based on the researches quoted and a few more general facts.

The egg of all birds and reptiles, when first formed within the body, is covered with a flexible membrane. At a large number of points in this membrane minute specks of lime appear. Round each of these specks more lime is gradually added in successive layers like the coats of an onion, thus building up little spheroids. When these spheroids meet one another, they form a complete coating to the egg, so that further layers of lime can be laid down only on the outer side of this. The layers outside any one spheroid thus build up a pile of irregularly prismatic shape and connect irregularly with the layers of the adjacent piles or prisms. On the inner surface of the first-formed coat each spheroid appears as a little hillock or mamilla; so this is called the "mamillar zone." The outer layers form the "prismatic zone." Outside the latter some of the membrane may remain as a "cuticle."

In chelonians the egg-shell is very thin, being composed only of the mamillar zone, with gaps remaining between the spheroids. In snakes the shell is still thin; the prisms are there, but they do not always join up. In crocodiles the shell is thicker than in turtles and in most birds, but the prismatic zone is scarcely developed; spaces, in the form of canals of two sizes, are left at intervals between the spheroids, so that air can reach the developing embryo. All birds have a mamillar zone and a relatively thick prismatic zone. In the Ratitæ the shell is thick and the air-canals branch as they near the outside, each ending in a group of pores. In the higher birds the shell is thinner and each canal opens in a single pore.

The deinosaur egg-shells already described by Dr. Van Straelen fall into three groups. In those associated with Protoceratops, from the base of the Upper Cretaceous, very small spheroids form a thin mamillar zone; the thick prismatic layer is traversed by relatively few air-canals, which end in minute pores and are of the same width throughout. In a Mongolian shell thought to belong to a duck-billed deinosaur the spheroids are larger, the pores a little larger, and the canals swell in the middle. In the shell from Provence the mamillar zone is much as in the last-mentioned; but above it are cavities which give rise to straight air-canals of equal bore, ending in pores of 0.1 mm. to 0.2 mm. diameter.

Thus the three types of supposed deinosaur eggs show a general agreement with one another. They differ from the eggs of all other creatures, but present certain resemblances to the eggs of crocodiles and birds, just as one would expect deinosaur eggs to do. We may therefore conclude that they really were laid by the deinosaurs the remains of which are found with them.

In addition to these three types, Dr. Van Straelen has in hand material from other parts of the world, including a probable deinosaur egg from the Oxford Clay of Peterborough and other eggs from the Oolite

of Great Britain. Now Mr. Roy Andrews tells us of one new type, of deinosaurian appearance, and another which is not so obviously deinosaurian.

The question whether all these eggs are those of deinosaurs has its converse: did all deinosaurs lay eggs? This cannot be taken for granted. The eggs of deinosaurs must have been hatched by the heat of the sun or of decaying vegetable matter, and it is natural to find them laid in rocks formed under desert conditions. To lay its eggs a deinosaur must have trod on *terra firma*. The huge sauropods that lived in the estuaries of Wyoming, Argentina, and Tanganyika can in many cases have climbed on to the land only with great difficulty, and it is even doubtful whether their limbs could have supported their enormous weight out of the water. It may therefore well be that, like the water-inhabiting icthyosaurs and sea-snakes, these monsters were viviparous. The East African Expedition of the British Museum is not likely to find their eggs in Tanganyika Territory.

Current Topics and Events

IN the course of an interesting account of the discovery in the Gobi Desert of forty more dinosaur eggs, representing three species, given to the correspondent of the *Times* at Pekin by Mr. Roy Chapman Andrews, the leader of the third expedition of the Natural History Museum of New York to Mongolia, which appeared in the issue of September 9, it is stated that implements of a type corresponding to the Azilian period of western Europe have been discovered by members of the expedition. These implements, made of red jasper, chalcedony and chert, were found under the sand dunes which are characteristic of the district, and include such forms as spear- and arrow-heads, axes and knives, and so forth, of careful workmanship. Pieces of egg-shell of dinosaur and giant ostrich pierced with holes were evidently used for ornament. In a more recent deposit were two fossil skulls with other evidence of a later culture, which is stated to be "probably neolithic," although bronze points are mentioned as among the finds. Other relics of early man found in this area include a few implements of Mousterian type and pictographs illustrating moose, elk, and other extinct mammals of which the relation to the other finds is not specified.

IT is obvious that this account of the discovery, apparently of primitive implements of human workmanship, must be received with all reserve until a further and more authoritative account is to hand; but it certainly holds out hopes of the fulfilment of the expectation that this expedition might well find traces of early man in Central Asia. The mention of implements of Mousterian type is of especial interest, coming as it does within a short time of the publication of the evidence for Mousterian man obtained by Fathers Licent and Teilhard de Chardin in Northern China and Mongolia, and the discovery of Mousterian implements associated with a skull of Neanderthal type in Palestine. It is stated that the earlier culture was separated from the later in stratification; but it is necessary that more should be known of the nature and character of the intervening deposits before it is possible to judge how far any wide separation in date is justified. The mention of bronze with the later culture may serve as a reminder that the contemporary use of metal and stone is of frequent occurrence. Stone implements from early sites in Mesopotamia have been known to be classified as Azilio-Tardenoisian until it was pointed out that their coexistence with copper had already been recorded. The geologists of the American expedition, however, appear to be satisfied as to the antiquity of the early deposits, which they date at somewhere "between 10,000 and 20,000 years old." The further conclusion that primitive man came to Europe from Asia is here made to depend upon a dating of the Azilian culture in western Europe of 7000 years, which is quite possibly too low.

A PLASTER cast of the skull and jaws of *Protoceratops andrewsi* has been received from the American Museum of Natural History and placed on exhibition in the Fossil Reptile Gallery at the British Museum (Natural History). This is not the type, but one of the best skulls obtained in 1923, and is nearly full grown. It is 21 in. long, $16\frac{3}{4}$ in. high, and $18\frac{3}{4}$ in. wide. The skull was found in the Djadochta Sandstone, a desert formation at the base of the Upper Cretaceous in the Gobi desert. Protoceratops is supposed to be the deinosaur that laid one kind of the famous eggs. It was herbivorous and one of the primitive Ceratopsia—a group of which Triceratops is the best-known example. It is not, however, regarded by the American palæontologists who have studied it as being in the direct line of ancestry of any of the American Upper Cretaceous genera, except perhaps Leptoceratops.

HOPES for the regeneration of China which were aroused by the prospect of liberating the funds accruing from the Boxer Indemnity seem likely to remain in abeyance for an indefinite period. The course of events at the moment is more than unfavourable to foreign intervention in domestic affairs, and in education, as in other matters, the Chinese, or at least the more aggressively demonstrative section of the population, do not hesitate to show their desire, and their confidence in their ability, to deal with the situation without outside assistance. In the meantime, the attitude of the students and the prominent part they are taking in the present disturbances lend support to the views of those with first-hand knowledge of the Chinese who are dubious of the advantages for China of an education on even partially Europeanised lines. It may be hoped, however, that this is but a passing phase which affects only the more restless and easily stirred section of the population. It must be remembered that in a country like China, in which, broadly speaking, scholarship has been the only passport to positions of authority, it was almost inevitable that the students would come to taking a hand in times of crisis, and equally inevitable that

here, as everywhere they would tend to follow a subversive policy

AN illuminating instance of the students power in China, though only in what might appear a trivial matter, is given by Mr Ellsworth Huntingdon, in *Scribner's Magazine* for September, in the course of an article in which he records the impressions of a recent visit to China He states that the women of Fuchow have been compelled at the order of the students, to abandon the three small swords it is customary for them to wear in their hair as a symbol of their right to defend themselves in case of need Although Mr Huntingdon s stay in the country was not prolonged and it is notoriously unwise to form a judgment of the people except on something approaching intimate acquaintance, he has grasped certain essentials of the situation There is conclusive evidence of the overwhelming desire of the Chinese man and woman for education up to the highest grade, but there are difficulties in the way in their desire for self sufficiency It is interesting to note that Mr Huntingdon is in agreement with the view which holds that the use of the Boxer Indemnity money by the United States for educating Chinese outside China has not been an entire success in that it has led to the undue Americanisation of the student—a result disliked by the Chinese and not ultimately beneficial for the individual The need for preserving what is best in Chinese culture, while allowing full scope to modern intellectual movements combined with high ideals of national welfare, has given rise to a suggested solution in a university which, combining several institutions under a common bond, might still allow free play to the aims and ideals of each of the constituent bodies This suggestion it may be noted, is not far removed from that which was put forward in these columns a few months ago in discussing the possibility of a scheme of co-operation between Great Britain and China

THE decision of the Pharmaceutical Society of Great Britain to establish pharmacological laboratories for the testing of drugs to which the provisions of the Therapeutic Substances Act apply, namely, drugs the purity of which cannot adequately be tested by chemical means, has been advanced an important step by the announcement that applications are invited for the post of Director The institution of the laboratories has been decided upon by the Council of the Society in order to afford opportunities for research in physiological methods of drug assay, to meet the demand for standardisation of therapeutic substances which will come from manufacturers, who for various reasons may not be prepared to undertake the standardisation contemplated by the new Act in their own laboratories, and also to afford opportunities for advanced students of pharmacy to receive training in the work The Pharmaceutical Society has recently revised its examination regulations, and pharmaceutical students who have obtained the Society's qualification of pharmaceutical chemist, either directly or through the recently instituted degree of Bachelor of Pharmacy of the University of London will be able to take advantage of the opportunities for advanced work provided by the laboratories and should eventually be able to meet the demand for persons with knowledge of physiological standardisation which will follow from the operation of the new Act The project has the complete approval of the medical authorities and among the members of the committee which is advising the Council of the Society on the appointment of a Director and on the lines upon which the laboratory should be organised are Sir Humphry Rolleston President of the Royal College of Physicians, representing the British Medical Association, Sir Nestor Tirard, representing the General Medical Council and Dr H H Dale representing the Medical Research Council The Ministry of Health and the Medical Research Council have given the project their approval and support from the beginning, and it is felt that the laboratories will not only achieve their immediate objects in connexion with the Therapeutic Substances Act, but will also make important contributions to the advance of medical science

THE Palæontologische Gesellschaft an international society of palæontologists, will meet at Weimar in Thuringia on September 24-29, under the presidency of Prof J F Pompeckj of Berlin The organising secretary is Prof Soergel of Tubingen who also will lead several of the excursions These include visits to travertine quarries near Ehringsdorf where relics of Neanderthal man have been found, to old gravels of the River Ilm with their vertebrate and cultural remains, to the Bunter sandstone of Berka, which shows worm-burrows and tracks of Chirotherium and to the Muschelkalk of Jena, besides the museums in Weimar and Jena Among papers announced are Prof O Jaekel, "The Problem of the Skull, a Memorial to Goethe's Morphology", Prof Scheidemantel, "The Monuments of Weimar', and Dr F A Bather, "Arenicoloides—a Suggestion," this last bearing on the worm-burrows of Berka

AT a recent meeting of the Aero Club of Norway, Lieut R Larsen outlined Captain R Amundsen's plans for a polar flight next year According to a report in the *Times*, Captain Amundsen has purchased from the Italian Navy a semi-rigid airship which was built in 1924 and has proved successful on several long flights It has a cubic capacity of 670,000 cubic feet and a length of 348 feet Three engines, each of 250 h p, give it a maximum speed of 250 miles an hour The crew will number sixteen, including Captain Amundsen and Signor Nobile, the constructor of the airship, who will act as navigating officer At the beginning of 1926 the airship will fly from Rome to Pulham and thence, after overhauling, to Vernes, near Trondhjem, and if circumstances are favourable, direct to Spitsbergen The final start will be made from King's Bay in April or May The cruising radius of the airship is 3725 miles, and the voyage across the pole is 2235, which it is hoped will be completed in about fifty hours Mooring masts are being erected at Vernes and at King's Bay

DR ALEŠ HRDLIČKA, of the Smithsonian Institution, is expected to make a short stay in England towards the end of September on his return journey to the United States after visits to India, Australia, and South Africa The object of Dr Hrdlička's journey to these countries was to investigate on the spot the evidence bearing upon the problems of early types of man While in South Africa he visited the famous Broken Hill Cave in which the remains of Rhodesian man were discovered, and in examining the deposits, was fortunate enough to discover further fragments of human skeletal remains He proposes to exhibit these at a meeting of the Royal Anthropological Institute, and to submit to the fellows of the Institute the conclusions at which he has arrived from his examination of the deposits in the caves Dr Hrdlička's intention, appropriately enough, is to hand these bones to the British Museum (Natural History), where they will take their place with the remains of Rhodesian man

THE twenty-fifth anniversary of the foundation of the Mond Nickel Works was celebrated on September 12 at Clydach, Glamorganshire, when Sir Alfred Mond, chairman of the Company, unveiled bronze statue of his father Dr Ludwig Mond, F R S, who died on December 11 1909 Dr Ludwig Mond's name is connected more particularly with the manufacture of alkali and alkali products In the late 'sixties of last century, he settled at Winnington in Cheshire, where, with the late Sir John Brunner, Bart, the firm of Brunner, Mond and Co was built up for the manufacture of soda by the Solvay or ammonia-soda process Much of the success which the firm achieved was due to the genius of Dr Mond The nickel works at Swansea arose out of the discovery, in collaboration with Langer and Quincke, of the group of compounds now known as the metallic carbonyls This work in an abstract field of research was with Dr Mond's characteristic aptitude for seeing practical applications, quickly turned to account, and a process developed for the extraction of nickel from its ores Dr Mond will also be remembered as a most generous benefactor of science The Davy Faraday Laboratory at the Royal Institution and the International Catalogue of Scientific Literature are two specific examples of his munificence, though practically every movement in his day for the advance of physical or chemical science owed much to him and to his wise and inspiring counsel Dr Mond was elected a fellow of the Royal Society in 1891, and on the death of his widow in 1923, the Royal Society and the University of Heidelberg each became a legatee for the sum of 50,000*l*, the income of which is to be employed for the endowment of research in natural science

A COLD spell was experienced in England at the commencement of September The mean maximum temperature for the first 10 days of the month at Greenwich Observatory was 62° 5 F, which is 7° 3 below the average for 65 years, 1841–1905 the mean minimum was 46° 9, which is 3° 9 below the normal The mean temperature was 54° 7 and 5° 6 below the normal In 1922, the mean temperature for September 1-10 at Greenwich was 55° 1, the mean maximum was 64° 0, slightly higher than this year, and the mean minimum was 46° 2, slightly lower than this year In 1912, the mean temperature for the period was 54° 7, being in precise agreement with the present year, the mean maximum was 62°, slightly lower than this year, and the mean minimum 47° 4, slightly higher than this year These are the only Septembers in the last twenty-five years having such cold days at the commencement of the month On 6 days of the first 10 days of September of this year, the mean daily temperature was below 55°, and on September 9 and 10 the maximum thermometer failed to touch 60° Frost occurred in situations open to the sky on 3 nights The coldest day was September 5, with a mean temperature 51°, which is 10° below the normal The maximum temperature in the 10 days at Greenwich was 68° on September 1 It is not exceptional for the shade temperature to register 80° during the period, and in 1911, at the end of the abnormal summer, the thermometer on September 7 and 8 exceeded 90° at Greenwich, and in the 10 days there were 5 days with a temperature above 80° In 1906 the shade temperature on September 1 2, and 3 exceeded 90°

THE experiment in agrarian colonisation in the Tripolis initiated by the Italian Government in the year 1922 forms the introductory article of the *Revista della Tripolitania*, an official publication dealing with matters relating to the Colony, of which the first issue has recently appeared The contents are not confined to official matters, and if the promise of the first number is maintained, it should prove a source of information of value for which systematic provision hitherto had scarcely been adequate in view of its importance, especially from the archæological and historical point of view In the present number there are several articles of interest to archæologists, including an account of the city of Leptis as a centre for the production of oil in Roman times, a well-illustrated account of archæological remains, and a description of an interesting mosaic from what apparently was a small votive shrine set up in the fields by a Roman citizen Prof A Ghigi publishes the first instalment of a survey of Libyan fauna The remainder of the first issue is composed of articles of practical interest to agriculturists, such as the cultivation of the olive, industries subsidiary to agriculture, the raising of cattle and goats in Libya, etc, and reviews of recent books dealing with the country

A PROJECT due to M P Gaudillau is described in the *Comptes rendus* of the Paris Academy of Sciences of July 6, which will take advantage of the difference of level between the Mediterranean and the Dead Sea It is proposed to construct a canal with locks from Haiffa up to a pass at the head of the valley of Esdrelon, where a tunnel two or three kilometres long will connect with another short canal leading down a valley to the head of the pipe line, the

latter will carry the water to the Jordan valley, running straight down the steep mountain-side, the available head being 343 metres. From the power-house in the valley the outflow will be in a canal running with a moderate slope along the side of the range, down to the Dead Sea, where an additional fall of 120 metres to a second power-house can be obtained. The Mediterranean water will be pumped from reach to reach of the canal by means of electric pumps. It is proposed to store the fresh water of the Jordan, and use it for irrigation; and as the present average flow of the river is about 70 m^3 per second, and this amount of water is now disposed of annually by evaporation, it is considered that, by raising the level and so increasing the surface of the Dead Sea, it should be possible to dispose of an influx of salt water of 103 m^3 per second. To raise this water 80 metres to the head of the pass will require 190,500 horse-power, and 617,000 horse-power will then be available for conversion into electric energy, 426,000 of which, or 240,000 kilowatts, will be available for distribution in Palestine and Syria.

THE inaugural meeting of the forty-fifth session of the Junior Institution of Engineers will be held at the Society of Arts on Friday, December 11, when Mr. J. S. Highfield will be inducted president of the Institution by Dr. Alexander Russell and will deliver his presidential address.

MR. F. W. H. MIGEOD, the well-known African traveller and authority on native languages, has consented to assume the leadership of the British Museum East African Expedition in succession to Mr. W. E. Cutler, whose death from malaria was announced at the beginning of September. Mr. Migeod will sail for Dar-es-Salaam by the next boat.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—Senior entomologist, Ministry of Agriculture, Egypt—H. E. The Under-Secretary of State, Ministry of Agriculture, Cairo (November 1). Chemical officer in the Medical Research Laboratory, Nairobi—Private Secretary (Appointments), Colonial Office, 38 Old Queen Street, S.W.1 (October 15).

Our Astronomical Column.

RECENT MODIFICATIONS IN THE THEORY OF STELLAR EVOLUTION.—Prof. H. N. Russell, who shared with Prof. Hertzsprung the honour of originating the giant and dwarf theory of the evolution of stars, is contributing a series of papers to the *Scientific American* (beginning in the September issue) on the changes of view that have taken place in the last year or two.

Prof. Eddington showed from statistics that when absolute magnitude and mass were correlated, giants and dwarfs lay on a single curve, in contradiction to the earlier view that an abrupt change took place at the point where the star became too dense to act as a gas.

The recent spectroscopic demonstration of the immensely high density of the companion of Sirius was a striking verification of Eddington's conclusion that the atom when stripped of its outer electrons is capable of enormous compression without ceasing to be a gas. This completely modifies the older conception of the falling temperature in dwarf stars. It now appears that the temperature in their interiors will continue to rise far into the dwarf stage. But a full consideration of the best manner of modifying the theory in view of the new facts is postponed.

OBSCURING COSMIC CLOUDS.—Father Hagen, of the Vatican Observatory, has during recent years published successive lists of what he describes as dark nebulæ, covering considerable regions of the sky, in both low and high galactic latitudes. Prof. Öpik, of Tartu Observatory, concluded from a count of the faint stars on the Paris Astrographic Charts that these were produced by some obscuring medium.

As this would be a matter of supreme importance in all researches on distant objects, Prof. Harlow Shapley has made a fresh investigation, by taking long-exposure photographs with 24-inch or 16-inch refractors. These show stars nearly 3 magnitudes fainter than the limit (14.5 mag.) of the Paris Charts. His conclusion (Harvard Coll. Ob. Circ. 278) is that the deficiency of stars in the regions in question does not extend to these fainter stars, as it would if obscuring clouds were the cause of it. In other words, the actual distribution of the stars brighter than 14.5 is much more irregular than the laws of chance distribution would suggest. Doubtless this is a manifestation on a larger scale of the well-known tendency of stars in many regions to group themselves along regular curves.

The "obscure nebulæ" of Father Hagen are concluded to be an effect produced on the eye by the great contrast in star density between the neighbouring regions. The star deficiency is real, but the appearance of a visible obscuring medium is illusory.

U.S. NAVAL OBSERVATORY ECLIPSE OBSERVATIONS, 1905–18.—The appendix to the Publications of the United States Naval Observatory, Second Series, Volume 10, Part 2, contains an account of the total solar eclipses of August 30, 1905, and June 8, 1918, with aviators' notes on the total solar eclipse of September 10, 1923. The first account opens with the general report of the 1905 Expedition by Rear-Admiral Colby M. Chester, who was Commander-in-Chief of the special line squadron of three vessels detailed by the Navy Department. Three principal stations were occupied not far from the shores of the Mediterranean, and each station was completely equipped for photographing the corona with long and short focus cameras, for spectroscope and polariscope work, for meteorological observations, and for position observations. At none of the stations was there any interference from clouds, and the programmes in general were carried out as planned. The volume contains the individual reports of all the officers in charge of the various departments, and covers 335 pages. It is well illustrated by a large number of excellent plates.

The reports of the 1918 eclipse, occupying 51 pages, are next dealt with. This eclipse was observed at Baker, Oregon, but partial cloudiness was responsible for the meagreness of the observations. Practically no spectroscopic results were secured.

Unfortunately the weather conditions for the eclipse of 1923 were also unfavourable at all points occupied by the naval aviators. The programme included photographs of the corona and the moon's shadow on the earth. Partly from the weather conditions and partly from the inherent difficulties of making such observations from aeroplanes, the photographs are stated to have no scientific value.

Research Items

Intellectual Grouping of Men —In a " Study of the United States Senate " Mr Arthur MacDonald, of Washington, D C, raises the question whether it is possible to arrive at any general principles concerning organisations of men, comparable to those already elaborated about animal organisations He thinks that all organisations of men, especially those of long standing, act according to laws most of which are at present unknown As a preliminary investigation, he subjects the transactions of a Senate of three sessions to a statistical examination He studies the attendances of members during each of the three sessions, the attendances of the various political parties, of business as against professional members, the frequency of remarks for each political party, the previous life and education of the senators and their success From these data he draws certain tentative conclusions the most interesting of which are, that the professional men average much higher in the frequency of their remarks than the business men that the professional men are in the majority, and that a large proportion were reared in the country, that the Democrats excel the Republicans in university education that more than half of the legislation initiated in the Senate receives little or no attention The method is suggestive, and a comparison with other countries would be of great interest It would however, be advisable, when presenting material of this kind, if instead of giving averages only some indication of their reliability were also presented

Vanishing Indian Tribes —The urgent necessity of recording Indian languages and grammar, as well as the traditions and folk-tales of N America before it is too late, is well illustrated in the introductory remarks which precede the study of Wiyot grammar and texts by Gladys A Reichard which has just been published as Pt 1 of Vol 22 of the University of California Publications in American Archæology and Ethnology In 1850 the peoples speaking the Wiyot language probably numbered about 1000 In historic times they occupied a territory of about 465 square miles on the shores of Humboldt Bay and the lower reaches of the Mud and Eel rivers in north-west California In 1910 at the time of the census their numbers had fallen to 58 full-blooded Wiyot, 13 partly of Wiyot and partly of other Indian blood and 81 partly Wiyot and partly white, making a total of 152 Further, there were only 11 full-blood Wiyot under twenty years of age In 1922, when the present investigation was made, there were not more than 100 persons living as Wiyot, of whom very few knew the language Some lived in two small settlements on Humboldt Bay, the others were distributed in groups of a few families in various townships It is noteworthy that where a Wiyot marries a member of another tribe, whether Athapascan or Yurok, the children speak the language other than Wiyot Seven individuals were employed in furnishing and checking the material It was found that the difference in individual pronunciation was so great as to be almost dialectal which makes it particularly regrettable that more extended sources of information could not be obtained A sketch of Wiyot culture was given by Kroeber in his Californian Handbook published in 1911

The Amœba of Dysentery —There have been many claims in the past of the successful cultivation of *Endamœba histolytica*, the parasite of amœbic dysentery, most, if not all of which have proved erroneous Some new research has recently been published (Proc Nat Acad of Sciences, U S A Vol 11, No 5 1925 pp 235 and 239) Boeck and Drbohlav have now succeeded by the use of a special culture medium This consists of slants in test-tubes of beaten-up whole egg coagulated in an inspissator The slant is covered with Locke s solution containing 1 per cent of crystallised egg albumin (human serum may also be employed) Inoculated into this medium, the amœbæ grow and multiply feeding on bacteria and blood corpuscles if these are added and persist for five days, but are most numerous at the end of 48 hours By sub culturing within this period the cultivated amœbæ have been carried on for more than 90 generations They maintained their virulence, and the ninety-third sub-culture five months from the original culture produced dysentery when inoculated into kittens Chiang has been able to transmit the *E histolytica* of human origin to rats, and the infection of rats is readily transmitted from rat to rat by association in the same cage The results of this investigation incriminate the rat as a possible carrier of the amœba of human dysentery

Specific Immunity of Tissues —*Science* for July 31 (No 1596) contains an address by Prof Elliott Prentiss on ' Specific Immunity of the Tissues and its bearing on Treatment He points out that every species of animal and plant has special preferences of habitat and food This applies even to micro-organisms parasitic in the human body many of which are localised in certain tissues (see also Nature February 16 1924 Vol 113 p 242) Thus in tuberculosis the tubercle bacilli rarely infect the muscular tissues Experiments were performed by injecting tuberculous animals and individuals with emulsions of muscle, and a certain amount of benefit resulted suggesting that the tissues resistant to a particular infection might be employed in the treatment of that infection

Insulin Treatment —In *The Fight against Disease* (the organ of the Research Defence Society) for July, an account is given of the records of some forty cases of diabetes treated at one of the London hospitals with insulin Three of the cases died—one from hæmorrhage after an operation, one from cancer and pneumonia, and one from coma The remaining 37 cases have done well and have been discharged from hospital to resume ordinary life Faith in the value of insulin is therefore absolutely justified The article is illustrated with a striking plate showing the condition of a patient before and after insulin treatment

Swedish Rainfall —In Part II of the Årsbok for 1924 of the Swedish Meteorological Service are published the full figures of rainfall observations for the year For each of the stations which number about a thousand, beside the total fall for each month of the year, there are given the fall on the wettest day of the month, and the total number of days on which rain and snow fell Each month is illustrated by a map, and there is a map of the year's rainfall Comparison with previous years shows that 1924 was almost everywhere in Sweden an unusually wet year, the average excess being 16 per cent Only in a few parts of the extreme south of the country was there a slight deficiency, which nowhere exceeded 10 per cent

Echo Sounding —An important article on this subject appears in the *Hydrographic Review* for May 1925, the semi-annual publication of the International Hydrographic Bureau The article is intended to

complete the information on this subject given in earlier issues of the *Review* (December 1923 and October 1924), and, while it contains little that is actually new, it collects certain scattered information from various sources in different countries Descriptions are given of various forms of apparatus, including the sonic depth-finder of the American navy and Behm's apparatus, with a report of trials carried out with the latter by the Danish navy The article concludes with a bibliography of the subject from 1912 to the present year The contents of this article comprise Special Publication No 4 of the Hydrographic Bureau

TIDE PREDICTION —The annual report of the Tidal Institute of the University of Liverpool just issued, describes the work of the Institute during 1924, the sixth year of its activity On the more routine side, its work has included analyses of tidal observations made at Liverpool (4 years) and at Portland (1 year), the latter being done for the Admiralty , at Ystad, on the Baltic (4 years observations), for the International Hydrographic Bureau at Monaco and at Portage Island, Canada, for the Canadian Tidal Survey Tidal predictions of the times and heights of high and low water during 1926 have been prepared for Liverpool Portland, and seven ports in New Zealand and Australia , these predictions made for or through the Admiralty have been executed on the new machine presented to the Institute last year and installed at the Bidston Observatory The machine, which is of the Kelvin type, and made by Lord Kelvin's firm is described and illustrated in the report , more harmonic constituents can be dealt with than by previous instruments of a similar kind, and various useful improvements are incorporated in the design In addition to the development of methods of analysis and prediction, with special reference to this machine, various theoretical dynamical researches on tides have been published or continued during the year The financial expenses of the Institute have been met partly by its earnings for commissions executed on behalf of other institutions but mainly by the Liverpool Steamship Owners Association

WELSH SLATE —The Welsh slate-quarries employing more than eight thousand men, produce the finest slates in the world, and furnish more than 80 per cent of the total output in the British Isles The National Museum of Wales has therefore done well to issue a small hand-book on "The Slates of Wales" written by Dr F J North, Keeper of Geology in the Museum It is a pamphlet of 66 pages, liberally illustrated, and presents an interesting subject in language intelligible to the general public There is a general part, dealing with the nature and origin of slate and the manner in which it has acquired its peculiar fissile structure The author might have brought out more clearly the fact that in the better-class slates practically the whole of the material has been reconstituted *in situ*, before and during the impression of the cleavage-structure The more special part of the work includes an account of the distribution of workable slates in the Cambrian, Ordovician, and Silurian formations of Wales, some description of the getting of slate and the manner of preparing it for the market, and an interesting history of the Welsh slate industry, which dates from the latter part of the eighteenth century There is also a good classified bibliography of the subject This little book, published by the Museum at Cardiff at the price of sixpence is admirably suited to engage the interest of the intelligent visitor and to kindle a desire for fuller knowledge

THE CONTINUOUS SPECTRUM OF HYDROGEN —The continuous spectrum of gases is of great theoretical importance from the astrophysical point of view as explaining the continuous spectra emitted by the sun and by stars Messrs H Schuler and K L Wolf describe in the *Zeitschrift fur Physik* July 18 a series of observations of the continuous spectrum of hydrogen from which they conclude that it is due to the reunion of dissociated atoms to form molecules and they express the opinion that this is also the case with other gases the molecules of which consist of more than one atom, including the halogens for the continuous spectrum of which Steubing has recently given another explanation Experiments show that the continuous spectrum of hydrogen which reaches from about 4800 A U to 2100 A U is not related in intensity to the Balmer series or to the many line spectrum of the gas The long wave-length boundary of the continuous spectrum agrees satisfactorily with that calculated from the heat of dissociation, which confirms the authors view as to the origin of the spectrum It is found that the intensity of the spectrum is strongly affected by the electric field with which it increases, and it is suggested that reunion of atoms to form molecules is facilitated in an electric field An experiment in which a very intense continuous hydrogen spectrum, with very few hydrogen lines was produced in calcium vapour to which a little hydrogen was added, is considered to support the above view Franck and Cario have shown that molecular hydrogen is dissociated by means of energy derived from excited mercury atoms, and it is thought probable that calcium atoms act in the same way and that it is the reunion of these dissociated hydrogen atoms which causes the continuous spectrum in the last-mentioned experiment

WATER IN CHEMICAL ACTION —A series of papers on the influence of water on certain chemical reactions, by L B Parsons is published in the July issue of the Journal of the American Chemical Society Solid potassium iodide and bromide both react immediately with moist chlorine, whereas no appreciable action occurs if the chlorine is dry It is shown that a minimum partial pressure of water vapour, approximately equal to the vapour pressure of a saturated solution of the components present during the reaction, must be reached before reaction can take place The reaction between hydrogen sulphide and iodine in ether solution runs to completion in the absence of water

$$H_2S + I_2 = 2HI + S$$

In the presence of water the reaction is incomplete

$$H_2S + 3H_2O + 3I_2 \rightleftharpoons H_2SO_3 + 6HI$$

The equilibrium point depends on the relative concentration of the water diffused daylight has no appreciable effect Atmospheric oxygen must be excluded from the system, however as it oxidises ether to ether peroxide (Clover, 1922), thus changing the nature of the whole reaction Many observations have been recorded of the ability of water to produce combination between various metals and iodine It is now shown however, that this property is not peculiar to water, but is possessed by many organic liquids A close parallelism exists between the ability of a liquid to bring about reaction between a metal and iodine and the solubility of the metallic iodide in the liquid Apparently the function of the liquid consists in removing the film of solid iodide from the metal surface These researches are of importance in view of the large number of varied cases known in which water acts as a catalyst

The Russian Academy of Sciences

A MEETING was held at the London Central Y M C A on Thursday, September 10 in connexion with the bicentenary of the Russian Academy of Sciences, the celebration of which at Leningrad and Moscow, has just been concluded The meeting was arranged on the initiative of the Science Section of the Society for Cultural Relations (S C R) between the peoples of the British Commonwealth and the Union of Socialist Soviet Republics (U S S R) Sir Richard Gregory, who occupied the chair, pointed out that the sole intention of the assembly was to send a message of appreciation and encouragement to scientific workers in Russia For two centuries the torch of learning had been kept burning by the Academy of Sciences, and though at times it had flickered, it had never been extinguished since it was lit One of the objects of the S C R was " To take any action deemed desirable to forward the intellectual and technical progress of both peoples " , and the meeting could therefore appropriately associate itself with representatives of science who had gone to Russia to take official part in the celebration of the bicentenary of the Academy Sir Richard Gregory referred appreciatively to Belopolsky's brilliant spectroscopic work at the Pulkova Observatory, and said that a forty-one inch object-glass was now being ground at the works of Sir Charles Parsons in Newcastle for use in the largest refracting telescope in the world, to be erected in Russia

Prof A N Kriloff a member of the Academy, gave some particulars of its establishment and early activities He pointed out that two hundred years ago Russia differed very much from other European countries and was described as a purely Asiatic State On the vast territory where now 150 millions have plenty of room to live, only eight millions were distributed Almost all the inhabitants were illiterate, no schools existing except some in monasteries for the education of the clergy Up to the time of Peter the Great, the only books were the Bible and books for church service, which were written in the old Slavonic language When Peter the Great founded the Academy of Sciences, after having assisted at a meeting of the French Academy in Paris during one of his voyages, he invited the celebrated Leibnitz to prepare the statutes, and signed at the end of his reign an " ukase " promulgating the foundation of the Academy, but his death occurred before the work of the new institution began Thus in a country with one single lay school created some twenty years before by Peter—the " Navigation School, ' which was managed by the Englishman Farquarson—an Academy of Sciences was established It seems that such an enterprise had no sound basis, as not only " science " did not exist in the country, but the language had no actual word for it The founders had the wisdom, however, to invite as the first members of the Academy not learned men and teachers of sciences only, but " creators ' of the science, such as the two brothers Bernoulli and Euler Euler was for fifty-seven years a member of the Russian Academy, and his far-reaching mathematical discoveries and works filled more than one half of the first hundred volumes of the proceedings of the Academy During the first forty years of its existence the Academy was not only a scientific body but also a school of education The Russian members had to carry out research work in natural science and also to elaborate the Russian literary and scientific language trying to approach the half Slavonic language of the books to the spoken language of the people The need to organise the language, and to establish a system was so acute that some fifty years later a special Academy for Russian Language and Literature was created This Academy had a special name—the Russian Academy—but in 1818 the new institution was joined to the Academy of Sciences to form one of its Sections and the Academy of Sciences entered upon its second century with three sections, namely (1) Physico-mathematics (2) Russian Language and Literature, and (3) History and Philology

" At the beginning of its second century " continued Prof Kriloff " we see the Academy to be a purely scientific institution of world renown in a country with a definite system of education from primary schools to universities with a well-developed literature, an elaborate scientific language, and scientists of Russian origin in different branches of sciences The work of the Academy proceeds quietly like the work of analogous foreign institutions and a great deal of it is devoted, as in the beginning, to the study of the vast territory of Russia and of its natural resources In its third century the Academy enters at a time when the country and the people, having gone through a war and a revolution, have re-created the government and are re-creating life itself on a new foundation but now the Academy stands on a solid ground and directs with certainty its researches and work to the benefit of the people and of the country The Academy numbers forty-one fellows and has several scientific institutions under its direction, a library with four and a half millions of volumes, and an archive In addition to biological institutions, other institutions are the physico-mathematical one, with a new Röntgen-ray equipment, and the seismological survey The mechanical works attached to this institution are able to supply instruments for international geophysical and geodetic research At the chemical laboratory a new section of organic chemistry was created in 1923, and a Radiological Institute was organised in 1922 The well-known Pulkova Astronomical Observatory is extending its activity to the south of Russia and will begin observations with new first-class instruments supplied this year from England Seven Museums belong to the Academy, namely the Geological, Botanical, Zoological, the Pushkin House, the Historical and Bibliographical Museum, the Museum of Ethnology and Anthropology, and the Asiatic Museum "

Prof P I Schmidt, curator of the Zoological Museum of the Russian Academy, gave an account of the organisation of regional survey work which has recently been instituted in the Republics In the course of his address he said Science is universal, and being the highest achievement of mankind, is its most valuable treasure From this point of view, science is certainly international But there is a kind of scientific research which is of special value for a definite country such are the branches which study the nature of a country, its flora and fauna, the history and the life of its population To rule a country and to guide it to prosperity and economic well-being, it is absolutely necessary to know the natural resources of the country its geographical and climatological conditions as well as the character and abilities of its population Research of this kind is of a special value in Russia with its numerous regions differing widely in climate and population During the past two centuries the

Academy of Sciences has played the first and chief part in the investigations of the natural resources of Russia and in the history and the study of the present conditions of its population The small towns of Russia were never deficient in people interested in natural science, archæology, history, ethnography These people steadily accumulated an extensive knowledge of the different regions they inhabited Small societies, local museums, archives, biological stations have existed for some considerable time But they could not before the Revolution unite their forces for the purpose of collaboration Now, on the contrary, the separate organisations are freely able to get into touch with one another

The first call for the organisation of regional survey came from the Academy in 1921, when an All Russian Congress of the Societies for Regional Survey was brought together in Moscow In January 1922 a Central Bureau of Regional Survey was organised at the Academy of Sciences, Leningrad, with a branch in Moscow This Bureau collected information about already existing institutions for regional survey, brought them into connexion with each other, and supplied them with every kind of help The Bureau also started a periodical *Regional Survey*, and published monographs and text-books on this subject In March 1923, some 231 societies, their branches and associated clubs were on the list with 285 museums, 21 biological stations, and 16 natural reserves or parks But a good many more societies have been started since and up to last June the number of institutions dealing with regional survey was more than 1000 A map of Russia, on which these societies are marked, represents a dense conglomeration of points

Many of the regional survey organisations have developed out of the former scientific societies, such as those in Vologda, Kostroma, Saratoff, Tamboff, and other cities Those societies had already recorded observation after long periods, and at present they have only enlarged their programmes and increased their activities A great many new societies of regional survey have also been created in small towns and villages

Museums represent the simplest and easiest way for the popularisation of scientific knowledge, and are therefore largely used for educational purposes But members of the societies do not restrict their work to such purposes they do their best to do some scientific research as well They organise meteorological and biological stations, and arrange excursions and scientific expeditions on a small scale in order to study the local conditions, ethnographical, statistical, and economic research is also undertaken by them Many of the regional survey societies pay especial attention to the history and archæology of the country they collect antiquities and study the history of the region Most of the societies start the publication of the results in their own separate papers, and such periodicals are often of great value and interest Some societies publish descriptions of their regions, for example, the regional survey society in a small town Usman of the Voronej province, has published a map of this district on the scale of 4 kilometres to an inch, with a fairly good description of the Usman district

The following resolution was then moved by Sir Arthur Smith Woodward "That this meeting of members and friends of the Society for Cultural Relations between the Peoples of the British Commonwealth and the Union of Socialist Soviet Republics sends cordial greetings and congratulations to scientific workers in the U S S R on the celebration of the bicentenary of the Russian Academy of Sciences, and in high appreciation of the great work by which the Academy has enriched the knowledge and culture of the world during the past two centuries looks with confidence to the future for further contributions to promote the intellectual unity of mankind"

Sir Arthur Smith Woodward, in proposing the resolution, said he did so with special pleasure because he was an honorary member of the Russian Academy, and had profited much by the researches of some of the academicians and other Russian men of science He had visited the seat of the Academy on three occasions under the old conditions in 1889, 1892 and 1903, and had learned to appreciate the facilities it afforded for scientific work He made his home with Dr Friedrich Schmidt in whose rooms he met most of the active naturalists of St Petersburg as it was then termed Dr Schmidt himself was the leading authority on the rocks and fossils of the Silurian System, and was still more widely known by his investigation of the deposits in which the carcases of the mammoth occurred in Siberia Inostransev professor of geology in the university, was busy with Russian stratigraphy and petrology, and trained several brilliant students Lahusen, of the School of Mines, produced the first Russian text-book of palæontology on modern lines Yakovlev and Tolmachev were also beginning their valuable researches on palæozoic geology Baron von Toll was studying the collections he had made in the New Siberian Islands, where he eventually lost his life In 1903 Salensky had just mounted the unique mammoth from Beres kova in the Zoological Museum, and had completed the first memoir on it Amalitzky was at work in Warsaw on the great collection of Permian reptiles which he had made on the Northern Dwina—one of the most important achievements in palæontology Karpinsky was directing the Geological Survey of Russia and publishing fundamental contributions to geology He must be ranked among the foremost geologists of Europe, and, though now in his eightieth year, still retains all his enthusiasm as the honoured president of the Academy Dr Karpinsky is highly esteemed in England, and received the Wollaston Medal from the Geological Society of London in 1916

Dr T R Parsons, in seconding the resolution, referred to the physiological work of Pavlov and others which he had opportunities of seeing during a visit to Leningrad and Moscow a few months ago The resolution was then put to the meeting and carried unanimously

Cordial messages of support of the motion were received from the following among others Prof A E Boycott, Mr Victor Branford chairman of the Sociological Society, Sir Frank Dyson Prof A S Eddington, Prof J J Findlay, Prof J W Gregory, Prof G H Hardy, Prof L T Hobhouse, Prof J S Huxley, Prof J N Langley, Prof A D Lindsay Master of Balliol Prof C J Martin, Hon Bertrand Russell, Prof J Y Simpson, Prof E Soddy, Sir Gilbert Walker, Mr H G Wells

The Literature of Radioactivity [1]

THE report before us of the Committee on X-Rays and Radioactivity of the National Research Council of the United States consists of a review of radioactivity and its problems as discussed in recent

[1] Bulletin of the National Research Council Vol 10, Part 1 No 51 Radioactivity Report of Committee on X Rays and Radioactivity, National Research Council By A F Kovarik and L W McKeehan Pp 203 (Washington, D C National Academy of Sciences, 1925) 2 25 dollars

years It is essentially a bibliography, not a developed account of the present state of knowledge in this subject

The authors have taken as their starting point the year 1916, for in that year was published the well-known book of Meyer and von Schweidler, which contains an almost complete list of references to the earlier papers in radioactivity The whole of the literature of radioactivity from that year until June 30, 1924, has been searched and the results recorded in this report The limits of time have been overstepped in a few particular cases where earlier papers had been overlooked in previous works or where later papers were of special interest Between the given limits the literature has been covered with remarkable thoroughness and very few, if any, papers have been missed One result of this thoroughness is that many papers of doubtful interest or value are included, and that criticism and comment are reduced to a minimum In general, the results and conclusions of an author are stated briefly and unless the matter is of wide interest or of prime importance, comment is withheld

The literature has been divided into seven main sections, under the following headings the radioactive transformations, the α-, the β-, and the γ-rays, nuclear structure and radioactive processes, radioactivity in geology and cosmology, and the effects of the radiations upon matter A concise account of each subject as it arises is given, and this is followed by reports on the papers published on the subject A most valuable feature of the book is the collection of tables at the end of each chapter In particular, we might mention the table of β-ray spectra and the table of γ-ray spectra deduced from β-ray spectra One error must be pointed out In the tables of p 68 and p 70, α-particles of range 3 8 cm are attributed to radium C, on the authority of Bates and Rogers These α-particles have never been detected Their presence is inferred from a knowledge of the transformations, and their range has been calculated from the period of radium C, using the Geiger-Nuttall relation

A point which may give rise to some discussion is an attempt of the authors to introduce a systematised nomenclature of the radioactive substances The symbol they propose consists of the atomic number of the element, followed first by the chemical symbol of the principal member of its series, and then by a Roman numeral indicating the genetic order of the radio-elements, for which the first two parts of the symbol are the same Thus the proposed symbol for uranium 1 is 92 U I, uranium X_1 will be 90 U I and uranium 2 will be 92 U II, and so on This system is simple and rational, and has many and obvious advantages over the names and symbols in general use But the latter, however arbitrary they may appear, were born out of the irregular and adventurous history of the subject of radioactivity and will not lightly be put aside for any system, rational though it be

The report contains references to about 1500 papers, nearly all of which have been published in the brief space of eight and a half years, that is, at the rate of 15 per month These figures show the need for a bibliography such as this, and also indicate the magnitude of the task undertaken by the authors They are to be congratulated on carrying out their arduous and difficult work in a most thorough way The result of their labours is a book which should save a great deal of time and trouble to workers in radioactivity

J C

University and Educational Intelligence

CAMBRIDGE —The E G Fearnsides Scholarship for research in the organic diseases of the nervous system has been awarded to Dr T K Maclachlan, Pembroke College

A STATISTICAL report on the universities of Canada for the year ended June 1924 has been published by the Dominion Bureau of Statistics It gives a total of 18,026 regular students excluding those in preparatory (pre-matriculation) classes Students of medicine numbered 2941, engineering and applied science 1949 theology 951, commerce 859, education 818, music 791, law 541, agriculture 526, household science 511 There was a very noticeable increase in the number of students pursuing " short courses," including courses organised in co-operation with the Workers Educational Association, summer schools, and short courses in agriculture, journalism " business,' nursing, and other vocational subjects Most of these courses were provided by the universities of Toronto, McGill, Manitoba, British Columbia, and Saskatchewan 1862 students followed correspondence courses, provided chiefly by Queen's University, Ontario, and the universities of Toronto and Montreal The current expenditure of all the universities amounted to nearly 1,800,000*l*, the largest spenders being Toronto and McGill, nearly 400,000 each, Alberta 206,000*l*, Saskatchewan 117,000*l*, Manitoba 114,000*l*, British Columbia 110,000*l*, Queen s 100,000*l* The report directs attention to the fact that in some cases denominational universities (in the province of Quebec) are subsidised by the government Of the total income rather less than one-fifth was in the form of fees, one-sixth was from investments, and one-half from government grants

A SURVEY of engineering education in the land-grant colleges in the United States is given in Bulletin (1925) No 5 of the Bureau of Education The following important changes, among others have taken place since 1910 Nearly all of the colleges have eliminated foreign languages from the curriculum or made them elective instead of compulsory On the other hand, greater attention is given to English and to economics and business administration, required or elective courses being included to an increasing extent in such subjects as corporate organisation and finance, business law, patent law, accounting and cost keeping, banking, and salesmanship Courses in highway and automobile engineering have been added to the curricula in many institutions There has been a marked tendency towards postponing specialisation, the first year, or even the first two years, being made common to all branches, and more attention being given to thorough training in fundamental subjects Much attention has been given to the orientation of freshmen Shop practice instruction has changed in character, the general tendency being toward the conversion of the college shops into shop laboratories for illustrating modern methods of shop production, and of factory organisation and management, rather than for the acquisition of manual skill such as is required in mechanics There has been some extension of the " sandwich " or co-operative system, especially in electrical and chemical engineering, under which the student spends half his time in the university and half in some industrial plant In the United States this practice was first developed systematically by the University of Cincinnati

Societies and Academies

CAPE TOWN

Royal Society of South Africa, July 15 —A J **Hesse** Note on South African Rhyncophora There are 270 species of the polymorphic genus Brachycerus in South Africa Their chief enemies are secretary birds bustards, and aviculand spiders The eggs, which are rarely found are deposited two or three at a time Some larvæ are used as food by natives Certain larval secretions form a native remedy for toothache The adult insects are used by the Zulus as pendants for necklaces Gradation of characters from species to species exists in certain groups —F G **Cawston** The molluscan hosts of South African Trematoda Cercariæ have been isolated from at least eighteen species of fresh-water mollusca in South Africa, including the three genera of Ancylidæ —R F **Lawrence** Note on the Arachnida of South-West Africa The relation of the Pseudoscorpions to the other groups of Arachnida was touched upon and, in illustration, a new species of Garypus from Sesfontein, South-West Africa was exhibited This species is exceptionally large, measuring 7 mm in length, and is found under thin layers of weathering limestone A new species of binocular spider, Diploglena closely related to the genus Nops, which only occurs on the islands off the mainland of Brazil and Venezuela, is a striking example of the degeneration of the eyes owing to disuse in spiders living under stones

PARIS

Academy of Sciences, August 3 —Charles **Nicolle** and E **Conseil** The production of an experimental preventative serum for exanthematic typhus Stages and solution of the problem The serum obtainable from the ass, after experimental inoculation with the disease, has preventative properties although the serum is not so rich in antibodies as the serum from human subjects recovering from the disease —Maurice **Frechet** The law of errors of observation —R H **Germay** The asymptotic solutions of the equations which define implicit functions, and on the asymptotic integrals of partial differential equations —G W **Ritchey** A new method of construction of large telescope mirrors —V **Nechvile** Determination of the proper motions of stars from the 5th to the 16th magnitude, photographed on the first negatives of Henry —Y **Rocard** The diffusion of light in fluids A comparison of the formulæ obtained by Vessiot-King, Ramanathan, and Gans —M **Aumeras** The state of hydration of calcium oxalate Under the conditions of the experiments described the salt had the composition $CaC_2O_4\ H_2O$ —René **Girard** The action of dilute solutions of acids on the ferrous metals —V **Thomas** A new type of organo-magnesium compound Starting with di-iodobenzene and magnesium, in addition to the formation of $C_6H_4I\ MgI$, there is evidence that some $C_6H_4(MgI)_2$ is produced —N **Arabu** Stratigraphic remarks on the fault of Ribeauville (Haut-Rhin), to the north of Strengbach —L **Jaloustre**, G **Danne**, M **Demenitroux**, and A **Maubert** The radioactivity of the waters of Contrexeville (Vosges) the Pavilion and Quai springs The water from the Pavilion spring contains 0 85 millimicrocurie of emanation and not exceeding 0 5 millimicrogram of radium per litre The Quai spring contains 2 5 millimicrocuries of emanation and 0 33 millimicrogram of radium per litre — — **Dedebant** The isolation of the dynamic tendencies in regions with a large daily variation of pressure —Louis **Emberger** The chondriome in plants —Emile **Andre** and Franck **Guichard** Contribution to the study of the fats from American palms Murumuru butter Details of the usual physical and chemical constants are given for this fat together with the results of methanolysis followed by fractional distillation of the methyl esters —E **Ivanoff** A new mode of conservation and transmission of trypanosomes and spirochætes in the larvæ of *Galleria melonella* The larvæ of *G melonella* can be utilised for assuring the continuity of cultures of trypanosomes in the laboratory, and for despatching them on a journey lasting several days

WASHINGTON, D C

National Academy of Sciences (Proc Vol 11, No 7, July) —Cornelia G **Benedict**, Francis G **Benedict**, and Eugene F **Du Bois** Human metabolism in an environment of heated air Observations were made on five subjects (3 men and 2 women) placed in an air-tight bag through which a stream of heated, dry air (about 85° C) was passed Loss of weight was 5 to 13 times greater than normal oxygen consumption increased slightly, while skin temperature was fairly uniform and only one degree or so above normal owing to the cooling effect of perspiration —Herbert M **Evans** Invariable occurrence of male sterility with dietaries lacking fat soluble vitamin E Progressive loss of sexual powers and interest occurs in male rats, but it can be prevented by feeding, from date of weaning, single natural foods which cure the corresponding female sterility Male sterility is often cured by protracted administration of vitamin E in ether extract of wheat germ —Karl E **Mason** A histological study of sterility in the albino rat due to a dietary deficiency Progressive stages of degeneration of the testes were obtained Feeding with lettuce, provided some normal seminiferous tubules remain, checks degeneration, or, if fed before it sets in, prevents it —Walter S **Adams** The relativity displacement of the spectral lines in the companion of Sirius (*v* NATURE, August 22, p 285) —W M **Davis** The basin range problem A recent visit to the Great Basin region, which includes all Nevada and parts of Utah, Arizona, California, and Oregon, provided examples confirming Gilbert's fault-block theory of the origin of many of the ranges —James **Kendall** and Beverly L **Clarke** The separation of rare earths by the ionic migration method An agar-agar gel containing a mixture of salts of two rare earth metals is placed in a wide tube between similar gels containing a faster cation (near the cathode) and a slower cation (near the anode) On electrolysis, the two boundaries remain sharply defined, but great care is needed in preparing the gels The cations of the rare earth mixture should have different ionic mobilities leading to their accumulation at the ends of rare earth gel section After runs of about twenty days with a current of 0 6-0 8 amp at 240 volts, during which the rare earth section was moved up to 400 cm, separation of an yttrium-erbium mixture was effected (99 1 per cent yttrium) and considerable separation of neodymium-praseodymium and gadolinium-samarium mixtures —R H **Fowler** and E A **Milne** A note on the principle of detailed balancing The principle of entire equilibrium announced by Prof G N Lewis has been exploited extensively in physics in recent years under the name (among others) of "the principle of detailed balancing"—W H **Rodebush** and E F **Fiock** The measurement of the absolute charge on the earth's surface Copper quadrants are mounted on insulators just above the ground and earthed through a ballistic galvanometer Rotating quadrants directly earthed can be superimposed, making the former quadrants virtually the

inside of a conductor The results indicate that the ground is negatively charged (10^{-10} coulombs per square metre), day and night (or solar eclipse) cause little change, but at the beginning of a rain-storm the charge drops to zero and may become slightly positive —Edward W **Berry** Fossil plants from the tertiary of Patagonia and their significance A collection from Mirhoja, Chubut Territory, contains determinable forms which are American and show no traces of African relationships The age of the deposit is Miocene, and all except one specimen, a grass, are dicotyledonous arborescent forms or lianas They indicate a genial climate with abundant rain for the period —Laurence H **Snyder** Human blood groups and their bearing on racial relationships —Carl **Barus** Inductance treated acoustically by differential telephones —Albert **Bjorkeson** X-ray radiation from hot sparks The X-rays originate chiefly at the solid electrodes —Edwin H **Hall** The four transverse effects and their relations in certain metals Knowing the electromagnetic coefficients (Hall and Ettingshausen effects) enables qualitative calculations to be made of the thermomagnetic coefficients (Nernst and Leduc effects) —Gilbert N **Lewis** The distribution of energy in thermal radiation and the law of entire equilibrium Anticipations of this law have been less general than is now claimed Its application to radiant energy is a crucial test It leads to an equation of the form of the Wien distribution equation, which is contradicted by experiment The Wien equation really applies to an "ideal" radiation analogous to an 'ideal" gas —Leonard B **Loeb** Ionic mobilities in ether as a function of pressure As in permanent gases, the newly formed ions have about the same mobilities, but that of the positive ion decreases in about 0 03 sec, due apparently to a change in the diameter of the ion with age —Richard C **Tolman** The principle of microscopic reversibility Lewis's "law of entire equilibrium" has been stated before under the name of "the principle of microscopic reversibility" It is regarded as "an unproved assumption"—John P **Minton** The dynamical function of the tympanic membrane and its associated ossicles Two modes of action are suggested at low frequencies, the drum vibrates as a piston and the ossicles act as multiplying levers setting up relatively large pressure changes acting on the oval window, at high frequencies, they conduct flexural vibrations of the drum to the oval window This explains middle-ear deafness to low frequency sounds and other effects —Linus **Pauling** and Albert **Bjorkeson** A new crystal for wave-length measurements of soft X-rays The plane 00 1 of the hexagonal crystal β-alumina (Al_2O_3) gives very strong first and second order reflections It has the unusually large grating constant of 11 2 Å U and should be valuable for wave-length determinations with soft X-rays —J **Hadamard** (1) On quasi-analytic functions (2) The approximate evaluation of definite integrals A better value is obtained by combining Simpson's value with the Euler-Maclaurin correcting terms

Official Publications Received

Department of the Interior Bureau of Education Bulletin, 1925, No 8 Elementary Instruction of Adults Report of the National Illiteracy Conference Committee Pp v+33 5 cents Bulletin, 1925, No 10 The Rural High School, its Organization and Curriculum By Prof Emery N Ferriss Pp vi+74 10 cents Bulletin, 1925, No 4 Land Grant College Education, 1910-1920 Part 3 Agriculture Edited by Walton C John Pp v+108+8 plates 25 cents Bulletin, 1925, No 5 Land Grant College Education, 1910-1920 Part 4 Engineering and Mechanic Arts Edited by Walton C John Pp v+75+7 plates 20 cents (Washington Government Printing Office)

The Physical Society of London Proceedings Vol 37, Part 5 August 15 Pp xix+266 355 (London Fleetway Press, Ltd) 6*s* net

Technical College, Bradford Diploma and Special Day Courses, Session 1925-26 Pp 192+26 plates (Bradford)

Year Book of the Michigan College of Mines, 1924-1925, Houghton, Michigan Announcement of Courses, 1925-1926 Pp 121 (Houghton, Mich)

Ministry of Agriculture and Fisheries First Progress Report of the Foot and Mouth Disease Research Committee Pp 43 (London H M Stationery Office) 1*s* 3*d* net

British Museum (Natural History) Precious Stones Series No 1, Set D3 5 cards in colour Series No 2, Set D4 5 cards in colour Series No 3, Set D5 5 cards in colour Series No 4, Set D6 5 cards in colour British Flowering Plants Series No 7, Set F10 5 cards in colour Series No 8, Set F11 5 cards in colour (London British Museum (Natural History)) 1*s* each set

Journal of the Indian Institute of Science Vol 8A, Part 1 The Photochemical Oxidation of Aromatic Hydrocarbons, I By J J Sudborough, H E Watson and B T Narayanan Pp 7 8 annas Vol 8A, Part 2 Kachi Grass Oil By Bijoor Sanjiva Rao and J J Sudborough Pp 9 27 1 rupee Vol 8A, Part 3 Argemone Oil By S Narayana Iyer, J J Sudborough and P Ramaswami Ayyar Pp 29 38 12 annas Vol 8A, Part 4 Essential Oil of *Cyperus rotundus* By B Sanjiva Rao, P B Panicker and J J Sudborough Pp 39 47 8 annas Vol 8A, Part 5 Dehydration of Rectified Spirit by means of Anhydrous Calcium Chloride By J J Sudborough and P Ramaswami Ayyar Pp 49 54 8 annas Vol 8A, Part 6 The Hydrolysis of the Amides of $\alpha\beta$=Unsaturated Acids and of their Saturated Analogues By A R Yathiraja and J J Sudborough Pp 55 69 1 rupee Vol 8A, Part 7 (1) Studies relating to the Acetone producing Organisms, by Gilbert J Fowler and V Subramanyan, (2) Mahua Flowers as Raw Material for the Acetone fermentation Process, by A G Gokhale Pp 71 87 1 rupee Vol 8A, Part 8 Studies in Esterification By B V Bhide and J J Sudborough Pp 89 127 1 8 rupees Vol 8A, Part 9 Constituents of the Marking Nut, *Semecarpus anacardium* Linn By D Satyanarayana Naidu Pp 129 141 8 annas Vol 8A, Part 10 Notes on some Indian Essential Oils By Bijoor Sanjiva Rao, J J Sudborough and H E Watson Pp 143 188 2 rupees Vol 8A, Part 11 Bromo Derivatives of Para methoxycinnamic Acid By K V Hariharan and J J Sudborough Pp 189 219 1 8 rupees (Bangalore)

Nyasaland Protectorate Geological Survey Department The Physiography of the Shire Valley, Nyasaland, and its Relation to Soils, Water Supply and Transport Routes By Dr F Dixey Pp 22 (Zomba)

Annual Report of the Executive Council of the National Institute for the Blind for the Year ended March 31st, 1925 Pp 78+15 plates (London 224 8 Great Portland Street)

Navy (Health) Statistical Report of the Health of the Navy for the Year 1922 Pp v+176 (London H M Stationery Office) 6*s* net

Sir John Cass Technical Institute, Jewry Street, Aldgate, E C Syllabus of Classes, Session 1925-1926 Pp 113 (London)

Department of Agriculture, Trinidad and Tobago Administration Report of the Director of Agriculture for the Year 1924 (Council Paper No 52 of 1925) Pp 26 (Trinidad) 1*s*

Battersea Polytechnic, Battersea Park Road, London, S W 11 Calendar of Evening and Afternoon Classes for Session 1925-1926 Pp 23 Free Technical College for Day Students, and Day School of Art and Crafts Calendar, Session 1925-1926 Pp 43+10 plates 3*d* Domestic Science Training College Session 1925-1926 Pp 23 6*d* Department of Hygiene and Public Health Pp 26+4 plates 3*d* (London)

Proceedings of the Geologists Association Edited by A K Wells Vol 36, Part 2, August 21st Pp 107 202 (London Edward Stanford, Ltd) 5*s*

The Hundred and Third Report of the Commissioners of Crown Lands, dated 30th June 1925 Pp 36 (London H M Stationery Office) 3*s* net

The North of Scotland College of Agriculture Calendar, Session 1925-1926 Pp viii+120 (Aberdeen)

Diary of Societies

TUESDAY SEPTEMBER 22

ROYAL PHOTOGRAPHIC SOCIETY, at 7 —Oliver G Pike Birdland Cameos

FRIDAY, SEPTEMBER 25

ROYAL PHOTOGRAPHIC SOCIETY, at 7 —J Vacy Lyle From Domesday to the "Scrap of Paper (A look round H M Public Record Office)

ASSOCIATION OF SPECIAL LIBRARIES AND INFORMATION BUREAUX (Conference at Balliol College, Oxford), at 8 45 —Dr R S Hutton The Present Position with regard to the Association of Special Libraries and Information Bureaux —A E Twentyman The Classification of a Specialist Library —Prof F E Sandbach Some Notes on the Library Co operation Committee and its Scheme of Inter Loaning between University Libraries

SATURDAY, SEPTEMBER 26

ASSOCIATION OF SPECIAL LIBRARIES AND INFORMATION BUREAUX (Conference at Balliol College, Oxford), at 9 30 —Miss R Rankin The Special Library Movement in America —T Coulsen Impressions of the 16th Annual Conference of the Special Libraries Association at Swampscott (Mass), June 1925 —M Otlet —Prof Alan Pollard L Institut International de Bibliographie and its Methods —Prof Gilbert Murray Some Notes on the Work of the Committee on Intellectual Co operation of the League of Nations —At 2 30 —T H Burton Abstracting —L S Jast Some Special Methods of Cataloguing Temporary Material —H L Robinson A Central Index of Technical Publications —R Borlase Matthews Efficient Filing —At 5 30 —Dr A E Cowley The Relation of the Bodleian to Special Libraries —At 8 —H A Slack The Information Work of the Daily Press —L Pendred The Inquiry Service of the Technical Press —Major W E Simnett Co ordination of Technical Intelligence

NATURE

SATURDAY, SEPTEMBER 26, 1925

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The National Need of Scientific Research and Research Workers

THE Prime Minister, in his speech to the House of Commons on June 29, expressed the view that, to find a way out of our present economic difficulties, one of the essential steps is "to link up science with our industries to-day" Lip service to this ideal can generally be obtained easily in most quarters, whether industrial, scientific, or political It is when we come to discuss practical methods of realising the ideal that differences of opinion become most marked The fundamental problem was admirably stated in the annual report of the Committee of the Privy Council for Scientific and Industrial Research for the year 1921–22 (Cmd 1735)

"The problem before the country, as we see it, is to provide a means which will enable its population of nearly 50,000,000 to live and prosper It is well recognised that for four-fifths of their food and for a great part of the necessary raw and semi-manufactured materials for industry, the people of these islands are dependent on supplies from overseas These supplies can only be obtained if this country is able to carry on its exporting industries in future with greater efficiency than the rest of the world, for it is doubtful whether we can compete, either by lowering wages beyond the limits of our competitors, or by securing a much greater human effort than they If these two avenues are closed, competition, in the end, is confined to greater efficiency resulting from scientific work, for, in the long run, our outstanding business skill and organisation could not make good a deficiency of production or an obvious inferiority in our goods We consider that scientific and industrial research is an essential factor *in the national effort on which the continued* maintenance of our present population unquestionably depends"

Two publications of recent issue have redirected attention to certain aspects of this problem The Research and Inventions Committee of the British Science Guild (6 John St, Adelphi, W C 2) has issued a report, published as a pamphlet, entitled "Scientific Research Workers and Industry" The National Union of Scientific Workers (25 Victoria St, S W 1) has recently issued, under the title "On the Encouragement of Fundamental Research," a report of the Research Committee of that body, presented to and adopted by the Council The two pamphlets are complementary, each to the other, the National Union of Scientific Workers confining itself to "fundamental" research of a purely theoretical nature, the British Science Guild being concerned with scientific research having a direct relation to industry

The publication of the British Science Guild is an admirable document, from which it is easy to see that great pains have been taken to acquire a solid basis of facts, often in face of great difficulties and of the

reluctance or failure of those bodies having the knowledge of the facts to impart them In a brief introduction and historical summary, it is pointed out that the Duke of Devonshire's Royal Commission on Scientific Instruction and the Advancement of Science set forth in its report, forty-five years ago, the paramount importance of scientific research, and urged the universities to assist in its promotion, stating that it was to the universities that the country must primarily look for its scientific workers Neither the State nor the older universities, to which the appeal was made, took any serious steps to supplement the inadequate supply of scientific workers The War opened the eyes of the country at large, and, since the War, developments in education and the establishment of the Department of Scientific and Industrial Research have already done much to foster scientific research and to bring about its better co-ordination with industry "Undoubtedly," says the Committee, "the supply of scientific workers has been greatly augmented and the question now arises as to the use made of them in industry" It is to this question that the Committee directed its labours and with which its pamphlet deals

Dealing with the supply of trained scientific research workers, the Committee of the British Science Guild, after an informative statistical statement of the data obtained by its inquiries, comes to the following conclusion "It appears that Great Britain has now just about reached the pre-War standard of Germany and the United States, judged by the ratio of students to population, but there is no reason to suppose that the other two countries have remained stationary, consequently there is no justification for deciding that we have now raised our educational status to a position worthy of our place among the other nations, and that there is no need for further expansion" It is pointed out, however, that the universities are short of money and expansion in research facilities is consequently curtailed, despite the facts that the total income of the British universities has been more than doubled, while the annual Parliamentary grant is now nearly five times that of the pre-War period

As to the utilisation of scientific research workers in industry, the chemical and engineering and allied industries probably employ most of the scientific research workers now engaged in industry An attempt has been made to get scientific research domiciled in other industries by the establishment, under the ægis of the Department of Scientific and Industrial Research, of industrial research associations for a number of important industries Very valuable work has been done already by these research associations, but, except in one or two instances, they do not appear to the Committee to be very extensively developed, the number of scientific research workers employed by them being comparatively small

The Committee of the British Science Guild says, however "The success of the Associations, so far as they have been developed, justifies in our opinion the very fullest extension of their activities" The Committee makes several constructive suggestions to this end In one of these suggestions it has already been anticipated in fact, namely, that the Government could offer considerable inducement to commercial firms to support research by permitting sums devoted to this purpose to be treated as trade expenses for the purpose of assessment for taxation By an arrangement with the Department of Scientific and Industrial Research, the Inland Revenue does allow the *annual* subscriptions of industrial firms to research associations to be so treated as a trade expense, and, moreover, the income of the research associations so derived is not subject to income tax

After pointing out "the vast gap there is, in many cases, between laboratory discovery and the commercial exploitation of a process," a gap often bridged only by years of skilled work, the Committee, in an Appendix, submits a memorandum on a proposed advisory committee on industrial inventions This committee would consist of experts and would have the following functions

(i) To examine the claims of inventions and to decide which are of probable industrial value

(ii) To arrange for the semi-large scale, or complete commercial trial, of these inventions which are passed by the committee

This is a valuable suggestion The Conference of Research Associations, at its meeting in July last, discussed the same problem, how to bridge the gulf between laboratory discovery and the large-scale application of the discovery to industry It is too big a question to be dealt with adequately here and now In many cases, but not in all, it is mainly a question of financing the large-scale trials needed, and it has been suggested that, over and above the funds available to the research associations for research as generally understood, there should be some development fund out of which grants could be made for this specific purpose of shortening the "lag" between discovery and application

The Committee of the British Science Guild directs attention also to the scheme adopted in the "A D Little" Laboratories in the United States, and suggests that a similar organisation "not in any way in competition with the existing Industrial Research Associations, but as a supplement to their activities," would perform a very useful function in Great Britain

This publication of the British Science Guild is

certainly a most helpful and constructive contribution to the solution of the problem, how "to link up science with our industries to-day" That problem will not be near to solution, however, until our manufacturers generally come to regard scientific research as essential a part and parcel of industrial organisation as are, say, insurance, advertisement, and sales organisation

We have but little space left to deal fully with the pamphlet issued by the National Union of Scientific Workers Much of it, perhaps necessarily from the scope of the subject, is rather of the nature of moral exhortation than of concrete proposal, and it reads at times a little tritely Nor are the authors always successful in "jining their flats" After declaring that the distinction between "pure" science and "applied" science, whether valid or not, is irrelevant to their purpose, they proceed to draw a vital distinction between "fundamental" research and "practical" research, as though this were not pretty much the same thing, and this distinction they base on what must generally be difficult, if not impossible, to determine, the "motives" which inspire the research workers Who can say what these motives are? Some day perhaps we shall reach that happy state in which it will no longer be worth while to define "pure" and "applied," "fundamental" and "practical," as applied to scientific research We shall be content to plead for thorough research, confident that if the research be thorough, the "pure" will look after the "applied," and the "practical" will not neglect the "fundamental"

Nevertheless, the National Union of Scientific Workers has performed a most useful service in directing attention to the paramount necessity, apart from any question of its practical application, of scientific research It points out that the encouragement of research involves the arousing of a right attitude towards research among the general public and the provision of the right atmosphere for the research worker, and makes important suggestions as to financial provision for research

Birth-Control Individual and Social Ethics

The Ethics of Birth-Control (Report of the Special Committee of the National Council of Public Morals) Pp xvi+179 (London Macmillan and Co, Ltd, 1925) 2*s* 6*d* net

THIS is a curious publication The spirit in which the Committee approached its task may be judged from the introductory remarks of the chairman, the Bishop of Winchester In these he says that many people regret the public discussion now given to such topics as birth-control, and that "in large measure the Committee share that regret"

It is this attitude which is in itself a serious matter Here is an invention—the mechanical and chemical control of conception—which is one of the few important biological inventions made in historical times The discovery of anæsthetics and that of various methods of killing or weakening the action of harmful bacteria are the only others that are in the same street with it It points a practical way to a final satisfactory control by man of his own evolution, since the only other regulators of numbers which are not merely pious wishes are war, pestilence, famine, or overcrowding Yet a serious body of public men regret, decades after its widespread adoption in practice, that it should be *discussed*

Many biologists and students of medicine remember the nausea which rewarded their first dissection or their first post-mortem It is a natural and almost instinctive reaction, and yet it is their duty and their privilege to be able to overcome it and so devote themselves to the search for truth or the relief of suffering The cases are precisely parallel

The net result of the Committee's deliberations is that its members continue to sit on the fence They find that the use of contraceptives may in special medical or even economic circumstances be advisable, but that self-restraint should always be the ideal One paragraph in especial deserves quoting as a dogmatic statement which to many will seem simply at variance with fact, and at any rate begs the question "The use of contraceptives is a symptom of the artificial character of our civilisation whereby for large numbers of people a simple healthy normal married life is difficult and in some cases all but impossible" Even from this very moderate condonation of birth-control, a minority, including Canon Lyttelton, dissent They say that the use of contraceptives is *never* to be condoned, and give as their chief reason that it is unnatural ("a frustration of God's design in Nature")

It would be very interesting to know which of the activities of civilised man the minority would call natural When I used to meet Canon Lyttelton regularly—when I was under him in Sixth Form at Eton—he (*inter alia*) taught us Latin, Greek, and Divinity, and did his best to stop beagling in the school Now I would quite respectfully submit that these activities are no more natural—or unnatural—than the practice of birth-control, and one of them—the antipathy to chasing wild animals—though I sympathise with it personally, yet is in direct opposition to one of the most ingrainedly "natural" propensities of humanity

No to damn a practice because unnatural is logically, to revert to a senseless Rousseauism From

one point of view civilisation is all unnatural. From another it is all natural, since it all springs from the nature of man: and as a matter of fact, the qualities in it which are usually regarded as more natural are just those which we share with the brutes, not those peculiar to our human dignity, and more often than not need repression instead of encouragement. It is meaningless to judge the practices of civilised man on this basis: they may justly be appraised as right or wrong, or as useful or harmful—but natural or unnatural, no.

Turning to the majority report, we find another defect which is characteristic, unfortunately, of too many idealists, both within and without the Church. They consider what they would like to see in existence, while partly or wholly neglecting what is in existence; and they run to extremes. It is pretty obvious that we should prefer to see more self-control in marital relations rather than more self-indulgence. But they do not seem to have reflected that such self-control as they recommend is not and certainly will not be for centuries "practical politics" for the mass of the human race. Among the distinguished people who gave evidence we find medical men, philosophers, social workers, clergymen, and others: one figure is conspicuously absent, and that is "l'homme moyen sensuel"—the type of the mass for which the Committee aspires to proscribe. For at least half the population for generations to come, the alternative to contraceptive methods is not self-control but the reverse, with as a result excessive child-bearing, with consequent misery, ill-health, poverty and degradation of standards.

Further, if there is one thing that is clear, it is that contraception has come to stay. Sir William Beveridge has made it fairly clear that to no other cause than the improvement of contraceptive methods can the marked drop in the birth-rate which started some fifty years ago be ascribed; for the suggestion of Brownlee that we are dealing with some undefined phenomenon of race-fertility cannot be entertained without much more cogent evidence.

Then our Committee runs to extremes. It may be true, as we said, that *more* marital self-control would be a good thing; but that does not in the least imply, as an elementary acquaintance with logic will convince, that *complete* self-control, save for the deliberate purpose of producing children, is the ideal. It is undoubtedly true that more self-control in the matter of eating would be a good thing, both morally and physically, for the nation; but that does not make complete abstention from food the ideal. A more real parallel is between the two aspects of eating and the two aspects of marital relations. We must eat to live, but we can also enjoy our food for its own sake. So we must practise marital relations to reproduce our species; but we can also find in them a means, as the Quakers put it, of "mutual endearment," or, in the more flaming words of Blake, make of it "that on which the soul unfolds her wing." If we are to refrain from all intercourse save that intended for procreation, we must logically disapprove of all devices, such as good cooking, designed to promote enjoyment of food, instead only of gluttony.

Finally there remains the biological aspect. The drop in the birth-rate has been differential. That of all classes used to be the same: in the last half-century or so the birth-rate of the professional and upper classes has fallen much more than that of the rest of the population. Although this is not such a dysgenic matter as is sometimes made out, since some very good stock, such as those of miners and agricultural labourers, show little drop in fertility, yet it *is* dysgenic: the proportion of desirables is decreasing, of undesirables increasing. The situation must be got in hand. But it is impossible to persuade the classes which have adopted contraceptive methods to drop them by idealistic appeals to self-control. The way to begin to stop the rot is to diffuse these practices equally through all strata of society. Then and only then can we draw breath and look round for more constructive eugenic remedies. But, meanwhile, as Mr. Wells in his letter in NATURE of July 25 suggests, we have no cause to be complacent about our intellectual and social freedom as compared with Tennessee; in the matter of birth-control we are doing a similar thing; we are preventing servants of the State from giving information on a vital topic, largely because of the attitude of certain religious bodies to the topic. Not only this, but while thus preventing the giving of the information where it is most needed, we take not the slightest steps to prevent it being given in a thoroughly unpleasant way, on a commercial basis—to those who can pay for it.

I make no apology for dealing with the subject at such length. We have here one of the most urgent matters of applied science with which our civilisation has been called upon to deal. Let us not bungle it as we bungled the whole human and social side of the application of science to industry at the time of the industrial revolution. I would recommend the separate report signed by Dr. Bond alone of the Committee as embodying a very cautious but a very sane attitude.

This booklet is interesting for much of the evidence which it contains; it is also interesting as showing that the Churches are alive to the existence of the problem. But we must regret that the report on the whole allows the question to fall to the ground between, on the one

hand, the stool of "natural" repugnances which ought to have been long ago overcome, and the stool of over-idealism on the other. When all is said and done, there is very little guidance here of a practical or social sort. The "ethics" of the book's title are chiefly individual ethics; the social ethics of the question are less fully and less broadly discussed. The over-concern of the individual for the salvation of his own soul was a characteristic of the Middle Ages. It springs up when there seems to be no prospect of reconciling the organisation of society with religious and moral ideals. To-day we do not feel that as an impossibility—however hard the task obviously will be; we see society as more plastic. We must be very careful not to allow the individual's concern about his own soul to loom so large as to stand in the way of social improvement or to block the social view. It would be an interesting task to try to discover how far the acknowledged lack of grip of the Church on the nation to-day comes from the retention of this spirit, which, however necessary a product of medieval times, is out of place in a society the leading minds of which are upheld by the consciousness that man through knowledge may acquire conscious control of evolution. But that is another story!

J. S. Huxley.

Mining and Metallurgy in the British Empire

Empire Mining and Metallurgical Congress, held in London, June 3-6, 1924. Proceedings. Part 1: General Section of Congress. Edited by the General Secretaries and G. F. Bird and Percy Strzelecki. Pp. xv+474+14 plates. Part 2: Mining (Section A of Congress). Edited by the General Secretaries and G. F. Bird and Percy Strzelecki. Pp. xvi+542+25 plates. Part 3: Petroleum (Section B of Congress). Edited by the General Secretaries and Dr. A. E. Dunstan. Pp. xvi+239+21 plates. Part 4: Metallurgy of Iron and Steel (Section C of Congress). Edited by the General Secretaries and L. P. Sidney. Pp. xiv+296+14 plates. Part 5: Non-ferrous Metallurgy (Section D of Congress). Edited by the General Secretaries and G. Shaw Scott. Pp. xii+137. (London: Empire Mining and Metallurgical Congress, 225 City Road, 1925.) Parts 1, 3, 4, 5, 10*s.* 6*d.* each; Part 2, 21*s.*; Set of 5 vols., 42*s.*

THE records of the proceedings of the first Empire Congress of Mining and Metallurgy have now been published in five substantial volumes, which will be found to contain much of interest to every one engaged in any branch of the numerous industries included under the headings mentioned in the titles of the volumes. It must not, however, be supposed that the importance to the British Empire of last year's Congress can be in any way properly gauged by the printed record of its proceedings. The real value of this Congress is to be found rather in its personal touch, in the essential fact that this was the first occasion upon which the men engaged in developing the mineral resources of the British Empire met together in conference, made each other's personal acquaintance and were able to discuss, both formally and informally, the numerous perplexing problems which they are called upon to solve in their daily routine. It may safely be said that the most valuable work that was done at the Congress was the work that will never be published, the heart-to-heart exchange of views for which it afforded so many opportunities, and to which the formal papers, which now lie before us in their permanent form, were so often looked upon mainly in the light of more or less unwelcome interruptions.

The importance of the subject-matters of this Congress can scarcely be overestimated, including as they do the employment in the service of mankind of the mineral wealth of our vast Empire; let it be remembered that the utilisation of the earth's mineral resources embodies human civilisation. The savage can live and does live on the organic products of the earth; but the dawn of civilisation only arose when man began to avail himself of the earth's inorganic products also, and every advance in civilisation and in the amenities of life depends upon the fuller and better use made of mineral resources. The work of mining and metallurgical technologists consists in discovering how to use these resources to the best advantage and how to supply them in the vast quantities and at the comparatively reasonable cost which the complexities of our modern existence imperatively demand. It is for this purpose mainly that the technologist calls upon science to come to his aid, and, as the records before us abundantly show, the application of scientific principles is playing an increasingly important part in helping the development of the mineral resources which Nature has placed at the disposal of mankind; never was there a time when the need for the employment of scientific methods was more urgent, for it would almost appear as though this were the only direction in which it is possible to seek for a remedy against the prevailing creed of work-shyness from which the Empire and Great Britain, in particular, are to-day suffering.

Whatever science and technology may effect, the basal fact remains, that we must necessarily look to labour to carry out the methods which the trained mining engineer and metallurgist may devise. In his recent presidential address to the Iron and Steel Institute, Sir Frederick Mills showed that the cost of production of all ordinary commodities includes from 90 to 95 per

cent labour cost, and this high figure emphasises strikingly the fact that it is labour alone which, in the ultimate resort, determines whether the articles which modern civilisation demands shall or shall not be supplied at a reasonable cost This point was admirably put quite recently in another presidential address, that of Sir Thomas Holland to the Institution of Mining and Metallurgy, and his words are worth quoting

"As civilisation, such as we know it, depends absolutely on our being able to rely on supplies of the base metals, each improvement in the treatment of ore adds enormously to the actuarial value of civilised life On the other hand, every increase in the cost of mining and metallurgical operations renders inaccessible correspondingly our available reserves As labour is the most important item in our working costs, a trades' union meeting can undo in a morning the results of a generation's research work in ore-dressing and metallurgy"

It is considerations such as these which serve to show the Empire Congress of Mining and Metallurgy in its true light as a bulwark of civilisation, based on the co-operation of those engaged in furnishing humanity with those materials which it has learnt to regard as indispensable to its present comfort and future progress Towards the attainment of this object, the free interchange of ideas between all English-speaking mining engineers and metallurgists (for it must not be overlooked that, in spite of the title of the Congress, American technologists were good enough to take part in it and to share in the deliberations of their British fellow-workers, to the great delight of the latter) is perhaps the most effective means that could have been devised

To turn to the published proceedings, it has already been indicated that they form the least important part of the real work of the Congress, in spite of the fact that they contain much information of the greatest use to students of technology There are five volumes, the first dealing with general subjects, and the four others devoted respectively to mining (coal and metalliferous), petroleum, iron and steel, and the non-ferrous metals The first volume contains a certain amount of what may be considered as ephemeral matter, records of proceedings, speeches at the Guildhall banquet, etc, but together with these there are three general papers of very great importance, namely, general reviews of mining and metallurgical practice in three great sections of the British Empire—Canada, Australasia, and South Africa—each of which contains a wealth of information concerning the development of their respective mineral resources which could only have been brought together on such a unique occasion as this Congress presented Perhaps it may be regretted that the Canadian paper deals somewhat too exclusively with the mining side of the question and that the great metallurgical developments in Canada are not adequately represented

The mining papers contained in the second volume, with but few exceptions, deal with the broad general problems of mining, such as should properly be considered at an Empire Congress, where detailed discussions of any one particular district are perhaps somewhat out of place A number of these papers are devoted to a review of general economic conditions, applicable to mining generally, and cover the broad field which more particularly interests such a Congress, whilst it is a highly significant fact that fully half of the papers are devoted to the all-important considerations of the safety, health, and wellbeing of the men engaged in mining operations It is surely a good sign that although Britain holds to-day the proud position of conducting its mining operations with a higher standard of safety than any other country in the world, we are not content with having reached this stage, but are striving onwards towards a still greater measure of security for the underground worker

The volume on petroleum may fairly be regarded as one of the best of the series, each paper dealing with one or other aspects of the subject, the economics, the geology, the methods of exploitation, the after-treatment and the storage and transport of the products being each one fully considered, so that this volume presents a complete epitome of the petroleum industry as it exists in the world to-day It may fairly be asserted that papers such as the above, showing the stage which the development of an industry has attained, are not only the most suitable for presentation to a Congress, but also likely to prove of the greatest permanent value to the future student of the subject

The volume devoted to iron and steel is necessarily less homogeneous than the last named, because the great complexity and numerous ramifications of this vast industry prevent any similar general treatment of the subject as a whole There are, however, a number of broad papers which deal particularly with the various principal branches, such as a review of coke manufacture, of fuel economy in general, of blast-furnace practice, of the production of various special steels, and of the economics of the iron and steel industry, whilst two papers describing the progress of the industry in Canada and in India respectively are of very special importance

The last volume, dealing with the non-ferrous metals, is perhaps the weakest from the point of view of an Empire Congress, but this again is due in a measure to the fact that it is called upon to cover so wide a range It falls to the lot of but few men to acquire a satisfactory working knowledge of more than one of the many

metals included in the non-ferrous group, and hence the presentation of general papers becomes a problem of extreme difficulty Several of the papers, such as that of Dr Rosenhain and Mr Archbutt on the alloys of aluminium, form important contributions to our knowledge of one particular metal, but would perhaps be better suited to the pages of the Journal of the Institute of Metals than to the records of an Imperial Congress, where breadth of vision is of more importance than microscopic accuracy of detail

It would not be right to conclude this notice without some reference to a matter which, although it occupies but an insignificant place in these volumes, being comprised within two pages of letterpress, will possibly prove to be the most important outcome of the Congress, namely, the foundation of an Empire Council of Mining and Metallurgical Institutions This Council proposes to act as the organ of co-ordination and co-operation between all these institutions throughout our wide-flung Empire, and, it is hoped, will form a common bond between all British mining engineers and metallurgists It should enable them more effectively to pool their knowledge and experience and to foster the already existing feelings of true comradeships between them In this way it should advance still further the development of our Imperial mineral resources, thus playing an important part in strengthening and maintaining the British Empire HENRY LOUIS

The God of Aristotle

Aristotle's Metaphysics A Revised Text, with Introduction and Commentary, by Prof W D Ross Vol 1, pp clxvi+366 Vol 2, pp iv+528 (Oxford Clarendon Press, London Oxford University Press, 1924) 2 vols 48*s* net

IN preparing this new edition of Aristotle's Metaphysics, Prof Ross has performed an arduous and a valuable service From many points of view the Metaphysics may be regarded as the hardest nut which Prof Ross has in the course of his great undertaking yet had to crack, and it is doubtful whether any of the works of Aristotle which have still to appear will present equal difficulty In the first place, the text is incredibly corrupt The earliest MS we possess is separated from Aristotle by a distance of twelve centuries, some of the books which are included are clearly intended to form part not of this but of a different work, other books necessary to the argument are missing, while there is acute controversy over the correct order of the books we have Finally, Aristotle's writing bears even more clearly than in his other works, evidence of being, not a mature treatise, but a series of notes for lectures or jottings preliminary to the preparation of such a treatise, the consequence being that, partly owing to the clipped and allusive character of Aristotle's remarks, partly owing to the gaps caused by the mutilation of the text, the amount of matter that has to be supplied by conjectural emendation is exceptionally large

The Metaphysics is exceptional, too, in the amount of controversy it has aroused, for the argument—and this is the second great difficulty with which Prof Ross has had to contend—is of unusual difficulty even for Aristotle, full of contradictions, repetitions, definitions which are neither used nor kept, preliminary statements which have no sequels, and divisions of subject-matter which are elaborately made only to be cut across by later and incompatible divisions The consequence is that when you have to use what Aristotle did say as a basis on which to conjecture what he may have said, while many guesses are plausible few can be more than guesses, so that different commentators have been able to indulge themselves even more freely than usual in their old trick of seeing in disputed passages confirmation for their own particular views

Through all this tangle of controversy and conjecture Prof Ross keeps a clear head He is sane in suggestion, sensible in judgment, he never advances a view without giving good reasons for it and for the rejection of contrary views, and he displays a knowledge and writes with an authority which fully entitle his edition to be ranked among the nobler works of scholarship Most valuable is a clear and full statement of the probable views of Socrates and Plato as disclosed by references in Aristotle, of the metaphysical views of Aristotle himself, and of his highly peculiar theology

I say views advisedly, and not system, for of all works on Metaphysics, Aristotle's is surely the most tentative and empirical There is no statement of general principles, no ordered advance from agreed premises, but tentative suggestions, fresh starts and reduction of common-sense views to more precise terms As Prof Ross puts it, the Metaphysics "expresses not a dogmatic system but the adventures of a mind in its search for truth"

It is matter for surprise that these adventures have attained their enormous celebrity Taken in the broad, Aristotle's speculations, especially with regard to the profounder truths, unlike those of Plato which give pleasure even when they do not carry conviction, are neither intellectually convincing nor æsthetically satisfying They owe much of the veneration with which they have been regarded to their somewhat arbitrary selection by the early Catholic Church as a basis for its theology Aristotle was the first to bring into philosophy the conception of "the prime mover" as the ultimate principle of the universe, a prime mover

who was spirit and not matter, and stood at the head of a hierarchy of spiritual essences This conception seems to have been enough for the Christian fathers Yet it is surprising that they should have embraced it so readily Aristotle's cosmology is one of great clumsiness, he announces six different kinds of being as the constituents of his universe, the prime mover, intelligencies actuated by love of him fifty-five in number, the soul of the first heaven, the souls of the fifty-five spheres, the first heaven, and the fifty-five spheres, and he makes no effort to resolve this somewhat grotesque plurality Furthermore, Aristotle's prime mover was not the creator of the universe, since matter is eternal, nor is he a personal God feeling interests outside his own concerns nor is he a God of love, since to entertain emotion would be to interrupt contemplation Contemplation is, indeed, the one pursuit of the prime mover, the objects upon which his intellect is directed being geometrical problems

In this, and indeed in other respects, Aristotle's prime mover is more like the ancients in the last play of the "Back to Methuselah" Pentateuch than the God of any known religion They, too, are engaged in the study of mathematics, their creator shares Aristotle's distrust of emotion and his respect for intellectual activity as the end and purpose of existence

C E M Joad

Our Bookshelf

Allen's Commercial Organic Analysis Vol 3 Hydrocarbons, Bitumens, Naphthalene and its Derivatives, Anthracene and its Associates, Phenols, Aromatic Acids, Gallic Acid and its Allies, Phthalic Acid and the Phthaleins, Modern Explosives Fifth edition, revised and in part rewritten Edited by Samuel S Sadtler, Dr Elbert C Lathrop, and C Ainsworth Mitchell Pp ix + 732 (London J and A Churchill, 1925) 30*s* net

This new volume while showing many changes in the personnel of the contributors, and some increase in size, very closely follows the ground covered by the corresponding volume in the previous edition published fifteen years ago The only definite change would appear to be the separation of the text on benzol with its derivatives from bitumens, so that it may be included later with dye intermediates With the extra space available, many of the more recent developments in analytical chemistry have received consideration The newer indicators for hydrogen-ion control and the comparative testing of antiseptics, to mention but two subjects, have received special attention

In spite of the fact that a large number of slips appear to have escaped the proof-reader, especially among the chemical formulæ (*e g* copper sulphate p 150, trinitroresorcinol, p 337, and cellulose trinitrate, p 598), the very high standard of the fourth edition has been maintained and all the sections have been brought up-to-date

In the examination of tars, pitches and oils, American standard methods have been followed A good account is given of the testing of natural gas in the bitumens section, but in the detailed description of the Orsat-Burrell apparatus the figure appears to have been omitted The fact that the testing of salicylic acid is given thirty pages and saccharin twenty pages, to take only two examples, gives some idea of the thoroughness with which this standard work is compiled The explosives section has been doubled in size since the last edition A big portion of the increase, however, is due to the inclusion of long extracts from the First Report of the Home Office Departmental Committee on the Heat Test (1914) The curious diagrams of this report, with dimensions inserted on simple apparatus to the third and fourth decimal point, are also reproduced The reference to Silberrad Ablett and Merryman (p 613) for the estimation of nitroglycerin in cordite, although similarly given in some other text-books, is incorrect, it should read Silberrad, Phillips, and Merriman The poor reproduction of Will's apparatus (p 704) makes the lettered description in the text of little value It is incorrect to dry tetryl by heating above its melting point (p 641) before determining this constant Reference is made in the explosives section to the new gelatinisers and stabilisers, such as diethyldiphenylurea and unsymmetrical diphenylurea, which were largely used in Germany during the War in the manufacture of propellants No method of testing these products is given, as it is stated that no method has hitherto been published

J Reilly

Pathologische Pflanzenanatomie In ihren Grundzugen dargestellt von Prof Dr Ernst Kuster Dritte, neubearbeitete Auflage Pp xii + 558 (Jena Gustav Fischer, 1925) 24 gold marks

The field of pathological plant anatomy is a difficult one to define, and the author has interpreted it in a broad sense This book, which now appears in a third and enlarged edition, fills much the same place in relation to pathological plant anatomy that Haberlandt's well-known work does to the "physiological anatomy" of normal plant tissues and organs It is an abundant source of carefully sifted information on the anatomy of pathological growths in their multiform variety Numerous clear illustrations add greatly to the value of the work

The special part opens with an account of variegation which occupies about 40 pages and deals with much of the modern literature of the subject from an anatomical point of view The second chapter is devoted to etiolation, the effects of the absence particularly of the short rays of the spectrum Not only the well-known effects on chromatophores and stems are considered, but also the effects of darkness on hair formation, pollen, endodermis, algæ, and fungi Three other chapters are devoted respectively to intumescences and similar structures involving increase of water content, wound tissues and regeneration, and galls The last two topics occupy 160 pages and include a consideration of callus, tyloses, wound cork, and gum formation

The general part is arranged in three sections dealing with the histogenesis, the developmental mechanics and the "ecology" of pathological tissues, making up the greater part of the book Here the facts are regarded

from a more philosophical viewpoint. Such general problems as senescence in plants, inhibitions to development, polarity, abnormal cell divisions, cell fusions and necrosis are considered on the basis of definite facts. The examples cited include anything from "involution" forms of bacteria to abnormal reduction divisions and the splitting of tissues by frost. As regards the *Entwicklungsmechanik* of pathological tissues, the causes discussed are classified as mechanical, osmotic, chemical, radiant energy and correlation. Under the latter head brief reference is made to gigantism and polyploidy, while Haberlandt's theory of wound hormones also receives consideration.

The final section deals "ecologically" with such topics as the healing of wounds, formation of aerenchyma and hydathodes, and with functional adaptation of tissues. The book is a most useful reference work for botanical laboratories, for one frequently finds the facts of pathological histogenesis considered from an unstereotyped point of view. R. R. Gates.

Practical Chemistry by Micro-Methods. By Prof. Egerton Charles Grey. Pp. ix + 124. (Cambridge: W. Heffer and Sons, Ltd.; London: Simpkin, Marshall and Co., Ltd., 1925.) 4*s.* 6*d.* net.

Forty years have now elapsed since the appearance of Haushofer's "Microscopic Reactions," and the science of qualitative microchemical analysis, of which it was the sign and portent, seems to have remained indigenous to Central Europe. Behren's "Introduction to Microchemical Analysis," the first edition of which was published in 1899, has become almost a classic, and the text-books of Schoorl and Emich have also achieved a well-earned reputation. Prof. Grey's elementary introduction to microchemical work is, we believe, the first English book to deal with this subject, and in extending a welcome to it, we hope that it will be the means of spreading the use of the microscope in chemical work.

Microchemical reactions are for the most part more decisive than the ordinary microscopic tests; they necessitate greater cleanliness and entail greater economy in time and material. Notwithstanding these facts, we cannot agree with the author that microchemical analysis should be substituted for ordinary analysis in our schools and colleges, though we grant that, at the appropriate stage, nearly every student would gain from such a course as he prescribes. It is a trite criticism that many secondary schools attempt work which is much better left to the university; here is a subject which pupils in their last school year could pursue with great advantage, and with this manual in hand they could work with very little supervision from the teacher. The low price of the book is also a recommendation, and prompts the question if it heralds a new dawn of cheap—and good—printing and publication.

Elements of Physical Biology. By Dr. Alfred J. Lotka. Pp. xxx + 460. (Baltimore, Md.: Williams and Wilkins Co.; London: Baillière, Tindall and Cox, 1925.) 25*s.* net.

For a long time methods analogous to those of statistical mechanics have been applied to animal and plant communities. But just as in physical chemistry these methods soon become intolerably cumbrous and may generally be replaced by thermodynamical calculations which ignore the individual molecule, so in the book before us the author has applied to biological problems a treatment of the type familiar in chemical statics and kinetics. These methods are applied to the growth of populations, whether of bacteria, insects, men, or railway engines, and to relationships between different species, for example, between a parasite and one or more hosts. The author has the problem of evolution always before him, and considers analytically the effect on population of a change in the behaviour of individuals.

It must not be supposed, however, that the book is a mere formulation of theories. It contains a vast amount of facts unattainable within the same compass elsewhere. For example, the account of the circulations of hydrogen, carbon, nitrogen, and phosphorus in Nature is the most satisfactory known to the reviewer, and accounts are given of the experimental work of Pearl and his pupils on animal populations, and the statistical results of Willis and Yule on "age and area." No biologist conversant with mathematics can possibly read this book without coming upon many ideas which will be new to him, and many mathematicians will find in it applications and problems of a refreshing novelty.

The Folklore of Fairy-Tale. By Macleod Yearsley. Pp. xiii + 240. (London: Watts and Co., 1924.) 7*s.* 6*d.* net.

In his brief preface, Mr. Yearsley modestly denies himself any claim to originality. His object is to bring together in a concise and popular form the salient points in the science of fairy-tales. He confines himself, where possible, to those tales which are current in the British Isles or have been introduced and popularised by British writers. His material, therefore, is largely drawn from Grimm and Perrault. In discussing the scarcity of the indigenous *marchen* type in Britain, he follows Hartland in attributing its suppression to the influence of Evangelical Protestantism. On this point he might have enlarged to the advantage of his readers. Hartland's suggestion indicates an important contributory cause; but it by no means entirely explains the facts. Why, for example, do British *marchen*, with one or two exceptions, survive especially in the areas in which revivalism usually flourishes? Mr. Yearsley illustrates his argument throughout with numerous examples and parallels. As many of the sources from which he draws his material are out of print or too technical for the ordinary reader, his book adequately serves the purpose for which it is intended.

An Elementary Chemistry. By E. J. Holmyard. Pp. viii + 424. (London: Edward Arnold and Co., 1925.) 5*s.*

Mr. Holmyard's book covers the syllabuses for the various First School Certificate and the London Matriculation Examinations. It is brightly written with a modern outlook, and should appeal to young students. Questions for exercise and useful "Revision Notes" (at the end of the book) are provided. Interesting historical notices, some portraits of famous chemists, and reproductions of manuscripts and pages of famous books enliven the text, and the whole treatment may be commended. The author has evidently appreciated the common difficulties and mistakes of young students, so that his experience may also be of assistance to teachers.

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE *No notice is taken of anonymous communications*]

The Taungs Skull

IN NATURE of July 4, 1925, p 11, Sir Arthur Keith has attempted to show first that I called the Taungs skull a "missing link," and secondly, that it is not a "missing link"

As a matter of fact, although I undoubtedly regard the description as an adequate one, I have not used the term "missing link" On the other hand, Sir Arthur Keith in an article entitled 'The New Missing Link' in the *British Medical Journal* (February 14, 1925) pointed out that "it is not only a missing link but a very complete and important one After stating his views so definitely in February, it seems strange that, in July, he should state that "this claim is preposterous

Despite this reversal of opinion Sir Arthur tells us that the skull 'does show human like traits in the refinement of its jaws and face which is not met with in young gorillas and chimpanzees at a corresponding age" He appears to have overlooked the fact that in addition to these and other facts brought forward by myself, the temporal bone, sutures, and deciduous and permanent teeth (according to Dr Robert Broom) also show human like traits Moreover, as Prof Sollas has so ably shown, the whole profile of the skull is entirely different from that in living anthropoids thus indirectly confirming my discovery that the brain inside the skull-dome which caused this profound difference was very different from the brains inside the skulls of modern apes

The fact that Sir Arthur was unable to find the *parallel sulcus* depression in the replica cast sent to Wembley illustrates how unsatisfactory the study of the replica can be in the absence of the original

With reference to the question of endocranial volume, I would state with Prof Sollas that this "is a matter of only secondary importance' Nothing could exemplify this matter better than the condition of affairs in the Boskop race, where the endocranial volume was in the vicinity of 1950 c c (The average European's endocranial volume is 1400-1500 c c) Indeed, the world s record in human endocranial volume (2000 c c) was discovered in a "boskopoid" skull by Prof Drennan in a dissecting room subject at Capetown this year It is well known that the elephant and the whale have brains much larger than those of human beings, but no one has inferred from that that their intelligence is greater It is fairly certain that size of brain has some relation to size of body, as Dubois has shown It is highly probable that the australopithecid man-apes were relatively small as compared with the gorilla It is not the quantity so much as the quality of the brain that is significant

Sir Arthur is harrowed unduly lest the skull *may* be Pleistocene It is significant in this connexion that Dr Broom who first directed attention to this possibility (of which I was aware before my original paper was sent away), regarded it nevertheless as "the forerunner of such a type as Eoanthropus" It should not need explanation that the Taungs infant, being an infant, was ancestral to nothing, but the family that he typified are the nearest to the prehuman ancestral type that we have

In view of these facts, there is little justification for the attempted witticism that in making the "African ancestors typified by the Taungs infant' the "foundation stone of the human family tree'—whatever that may be—I am making "a mistake identical with that of claiming a Sussex peasant as the ancestor of William the Conqueror" This is merely a case of mistaken identity on the part of Sir Arthur I have but translated into everyday English the genealogical table suggested by Dr Robert Broom (NATURE, April 18, 1925), with which I agree almost entirely I take it however, as a mark of his personal favour that Sir Arthur should have attacked my utterance and spared Dr Broom s

Sir Arthur need have no qualms lest his remarks detract from the importance of the Taungs discovery —criticism generally enhances rather than detracts Three decades ago Huxley refused to accept Pithecanthropus as a link To-day Sir Arthur Keith regards Pithecanthropus as the only known link There is no record that Huxley first accepted it, then retracted it but history sometimes repeats itself

RAYMOND A DART

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PROF DART is under a misapprehension in supposing that I have in any way or at any time altered my opinion regarding the fossil ape discovered at Taungs From the description and illustrations given by him (NATURE, Feb 7, 1925 p 195) the conclusion was forced on me that Australopithecus was a member of "the same group or sub-family as the chimpanzee and gorilla" (NATURE Feb 14 1925, p 234) In the same issue of NATURE Prof G Elliot Smith expressed a similar opinion, describing Australopithecus as "an unmistakable anthropoid ape that seems to be much on the same grade of development as the gorilla and chimpanzee without being identical with either"

All the information which has come home since Prof Dart made his original announcement in NATURE has gone to support the close affinity of the Taungs ape to the gorilla and to the chimpanzee—it is a member of that group Prof Bolk, of Amsterdam, and Prof Wingate Todd, of Cleveland, Ohio, have directed attention to the fact that the skulls of occasional gorillas show the same kind of narrowing and lengthening as has been observed in that of the Taungs ape Prof Arthur Robinson has shown that there is a wide variation in the size of jaws of young chimpanzees of approximately the same age the smaller of the jaws approaching in size and shape to the development seen in the Taungs ape The dimensions of the erupting first permanent molar of the Taungs ape and the form of its cusps point to the same conclusion—that Australopithecus must be classified with the chimpanzee and gorilla It is, therefore, "preposterous' that Prof Dart should propose to create "a new family of Homo-simiadæ for the reception of the group of individuals which it (Australopithecus) represents" It is preposterous because the group to which this fossil ape belongs has been known and named since the time of Sir Richard Owen

The position which Prof Dart assigns to the Taungs ape in the genealogical tree of man and ape has no foundation in fact A large diagram in the exhibition in Wembley, prepared by Prof Dart, informs visitors that the Taungs ape represents the ancestor of all forms of mankind, ancient and modern Before making such a claim one would have expected that due inquiry would first be made as to whether or not the geological evidence can justify such a claim From his letter one infers that Prof Dart does not set much store

by geological evidence Yet it has been customary, and I think necessary, to take the time element into account in constructing pedigrees of every kind Dr Robert Broom and, later Prof Dart's colleague Prof R B Young have reviewed the evidence relating to the geological antiquity of the Taungs fossil skull, and on data supplied by them one can be certain that early and true forms of men were already in existence before the ape's skull described by Prof Dart was entombed in a cave at Taungs To make a claim for the Taungs ape as a human ancestor is therefore "preposterous

Finally Prof Dart reminds me that whales and elephants have massive brains and that many large-headed men and women show no outstanding mental ability Still the fact remains that every human being whose brain fails to reach 850 grams in weight has been found to be an idiot Size as well as convolutionary pattern of brain have to be taken into account in fixing the position of every fossil type of being that has any claim to be in the line of human evolution—the Taungs brain cast at Wembley possesses no feature which lifts it above an anthropoid status ARTHUR KEITH

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London, W C September 5

The Rate of Man's Evolution

ALL those interested in the important question of man's evolution will have read with pleasure Sir Arthur Keith's recent contribution to this problem in NATURE (August 29, 1925) It is with some diffidence therefore, I record the fact that I am unable to agree with certain of his conclusions He states in the article above mentioned (p 317), that the Ice Age terminated "some 12 000 years ago," and again (p 319) that the well-known palæolithic epoch—the Mousterian—"closed some 20 000 years B C" It is, however, known that the close of palæolithic times coincided with that of the Ice Age, and thus, according to Sir Arthur Keith's dating, the distinct and widespread civilisations of the Aurignacian, Solutrean and the Magdalenian together with the change of climate and of fauna that accompanied them, can have occupied no more than 10 000 years

Again (p 319) your readers are informed that 'the Chellean phase of culture was moving towards its zenith 100,000 years ago" But, in view of the fact that there is good reason to believe the Chellean phase is referable to the Cromer Forest Bed and that two major glaciations with their inter-glacial periods, have occurred since the Forest Bed was laid down it is, I think perhaps unwise to assign any implements of Chellean age to an epoch so comparatively recent as 100 000 years from the present

To suppose these things is surely to exceed the archæological and the geological speed limits ?

The recent discovery, in a cave in Galilee, of portions of a human skull of Neanderthal type has a direct bearing upon the matter under discussion in this note In Mr Turville Petre's account of this find (*Times*, August 14, 1925) he states that the specimens were found in an undisturbed deposit containing flint implements, which "seem to indicate a transition culture from Early Palæolithic, or Acheulean, to Middle Palæolithic, or Mousterian" If this determination is correct, then it is clear that the skull fragments must be referred to the *beginning* of the Mousterian period Yet Sir Arthur Keith claims, for some unreported reason, that the Galilee individual lived about 20,000 years B C, which, according to his own dating is when the Mousterian period *ended*

As for the antiquity of the modern type of man, I am compelled to conclude, after a review of all the evidence that the discovery of human bones of this type in ancient deposits at Galley Hill and elsewhere support definitely the reality of this antiquity

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The Cause of Surface Tension

IN an article in NATURE for April 4 (vol 115 p 512) Mr N K Adam revives the old question as to the reality of a state of tension in the surface film of a liquid, and expresses grave doubts as to its existence I myself fell into this same heresy in my first flush of enthusiasm over Laplace's theory of capillarity, what eventually led me back into the fold was the contemplation of simple cases like the following

Consider a drop of water hanging in equilibrium below a hole in the bottom of a vessel of water and for definiteness let us mean by the 'drop" the water below some horizontal plane P drawn very close to the bottom of the vessel The drop is acted on by two downward forces its weight and a net downward push exerted by the water above for there can be no doubt whatever that over the plane P the hydrostatic pressure exceeds atmospheric

Now the crucial question is, what upward force balances these two downward forces ? It is no good arguing about resultant inward forces on the surface particles of the bottom part of the drop, for not even a water-drop can lift itself by its own boot-straps Some portion of matter outside the drop must be pulling or pushing upward upon it The only matter that can be doing this is the contiguous water above the drop But cohesion by the central part of this water cannot be the cause for the *net* force exerted by the central part, due to kinetic or contact pressure minus cohesion, constitutes the force of hydrostatic pressure referred to above, and certainly acts downward We are inevitably driven to the conclusion that the surface skin of the adjacent water above P is, on the whole, pulling upward upon the surface skin of the drop

This is all that we mean when we say that the surface skin is in a state of tension, any selected portion of the skin pulls harder than it pushes upon each adjacent portion Note that the maintenance of the equilibrium of a surface molecule is quite a different matter that depends upon the sum of all pulls and pushes taken together, and has no bearing on the question of the relation between pull and push in a given direction

This argument is very elementary and old, of course But I cannot find where any one has pointed out how simply the tension can be deduced also from those same Laplacian conceptions which have proved so misleading to many

Let us in thought divide the surface skin by a perpendicular plane R, and let us consider a horizontal slab of the liquid of unit width, of thickness dx, and extending perpendicularly from R to a point on the right beyond the molecular range of action, h The liquid to the left of R will attract this slab with a component of force normal to R equal, say, to tdx, and it will also press upon the slab with a force pdx where p = intrinsic pressure, which we assume to be equal in all directions at a given point in consequence of the fluidity (We omit the superposed action of the hydrostatic pressure) Then in the interior

$p=t$, whereas at the surface $p=0$, while t has here just half of its value in the interior, representing the attraction of half of a hemisphere upon the slab We may therefore conclude that in the surface skin on the average $t>p$, and the skin to the left of R will exert a net pull upon the skin to the right equal per unit length to

$$T=\int_0^h (t-p)dx$$

T is the "surface tension"

This argument involves no assumption of any special mechanism or arrangement of molecules on the surface, such an arrangement different from the state of the interior, may exist, as a separate phenomenon, or it may not The argument does, however, lose most of its meaning if one adopts the modern idea that h is really very short perhaps less than a molecular diameter The difficulty is not to conceive how the state of tension can exist, but to show from molecular behaviour that it *must* exist The surface must be a kinetic affair, with large momentary fluctuations of form and of molecular concentration, so that tension and pressure become mere statistical averages Perhaps nothing more is possible for the theorist than to fall back on physical instead of molecular considerations, and to conclude from these that the dance of the surface molecules is so ordered as to make the mean horizontal tension exceed the mean pressure

E H KENNARD

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THE water drop hanging below an orifice takes up such a shape that the relation between the pressure difference p inside and outside the surface, the potential energy per unit area of the surface γ, and the radii of curvature of the surface R_1 and R_2, is

$$p=\gamma\left(\frac{1}{R_1}+\frac{1}{R_2}\right)$$

This relation is deduced simply from the fact of potential energy in the surface proportional to its area and holds good whatever the law of force or mechanism by which this potential energy is produced (See, for example, Besant and Ramsey, "Hydrostatics," 6th ed, p 192, Gibbs "Equilibrium of Heterogeneous Substances," Works, vol 1, p 228) It is sufficient to account for the equilibrium of the drop The fluidity of the water allows it to attain the configuration of least potential energy very rapidly, and this will be such that the curvature at each horizontal section is exactly that necessary to give an internal pressure at the level of that section, equal to atmospheric pressure plus the pressure due to the column of water above that section Greater curvature will be necessary at the bottom of the drop than at the top In my article in NATURE of April 4, I suggested that the greater internal pressure under a convex surface of liquid might be pictured as due to the convergence of the normals to the surface, drawn inwards, the attractive forces on molecules in the surface act along these normals These inward forces are the cause of potential energy in the surface, since work must be done to form a new surface by dragging molecules from the interior Since the relation between curvature and internal pressure can be deduced independently of the mechanism causing the surface potential energy, it is evident that the inward attractive forces on the surface molecules can set up the pressure distribution within the drop which is consistent with minimum potential energy No more is required to account for the equilibrium of the drop

I think Dr Kennard is mistaken in his treatment of the statics of the problem The molecules of water are moving across the plane P continually, so that any attempt to regard the drop merely as a piece of inert heavy baggage, which leads to the conclusion that it cannot be held up by cohesion in the centre, is not clear enough to give a solution It does not help, when meeting the difficulties arising from this point of view, to ascribe the support of the drop to a hypothetical surface skin, about the properties of which nothing is stated The consideration of the pressures at different levels in the drop at once gives the solution, as it so often does in hydrostatical problems The motion of the particles of the drop, including exchange between surface and interior, is so rapid that it is not possible to ascribe the supporting of the weight of the drop to any particular region, and the method of pressures appears the only one available

Dr Kennard's expression for the "tension" deduced from Laplace's theory seems quite sound as an expression for the average deficiency in internal pressure in the surface layer But I can see no reason for calling this a tension It might be properly termed a state of rarefaction A rather similar argument was I think, employed by Worthington (*Phil Mag* 1884—I am without means of verifying the reference), who considered that there was probably a deficiency in density near the surface and therefore there must be a tension in the surface to separate the molecules Such arguments as these seem to be inspired more by the desire to employ the word 'tension,' with as many as possible of its associations, in connexion with the surface, than by any clear picture of what really is the structure in the surface

There are other reasons than Laplace's theory for not regarding the surface as containing any material structure like a contractile skin I have found three of these particularly convincing Following Langmuir, in the attempt to unravel the structure of thin surface films, I found that it led nowhere to speculate how the fatty acid molecules acted on the surface skin so as to diminish its "strength" But regarding the molecules of the fatty acid film simply as hard floating objects attracted by the water perpendicularly to the surface, attracting each other laterally, and small enough to show Brownian movement, very complete analogies have been drawn between these films and matter in three dimensions and the shapes of the molecules have been shown to be exactly what would be expected from their structural formulæ obtained by the methods of organic chemistry It would be scarcely possible to find a stronger *a posteriori* argument against the existence of a contractile skin than this success obtained by its total abandonment

Osborne Reynolds found that the motion of oil spreading on a dust-covered surface of water suggests strongly that the oil is spreading by reason of an inherent expansive force, and does not resemble at all that to be expected if the oil were being pulled out by the tension of a skin on the water He was considerably puzzled by this, as he felt bound to consider the expansion of the oil as due to the tension of the water surface (Works, vol 1, p 410, Brit Assoc Rep, 1881)

Maxwell (Works, vol 2, p 553, "Ency Brit" art on Capillarity) considered what would occur if the surface tension between two liquids became

negative, concluding that in this case we should expect the interface to extend itself spontaneously, by folding and puckering He pointed out that liquids do actually mix by diffusion, which is molecular motion Some such puckering of the interface seems to be a necessary consequence of a "contractile skin" becoming negative in tension and becoming an expanding skin No genuine case of mixing of liquids in this manner seems to be known, with Mr Jessop I have recently examined what was reported as a case, but found it due to a peculiar combination of gravity and diffusion, only possible in very special circumstances, and not connected with capillary phenomena (Proc Roy Soc, A, 108 324)

Regarded solely as a convenient mathematical equivalent for the potential energy associated with unit area of the surface, the term surface tension avoids constant reference to the principle of virtual work, and shortens calculations but as a means of gaining insight into the molecular structure of surfaces there is evidence that it has proved very misleading

N K ADAM

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September 2

The Miller Effect and Relativity

IT is reasonable that the unexpected results of the recent repetition of the Michelson experiment by Prof D C Miller should have made Dr Silberstein say that they "knock out the relativity theory radically" (NATURE, May 23, p 798) But though Einstein has built the special Theory of Relativity on the negative result of the experiment, I am of opinion that the Miller effect does not prove anything against the *general* theory It should be stated emphatically that *the special Theory of Relativity can only be built up rigorously if based upon the general theory*, not inversely The special theory does not consider any but linear transformations But avoiding every acceleration implies the impossibility of comparing measures and clocks moving relatively to each other On the other hand the usual supposition that the effect of a passage from rest to uniform motion, etc, tends to zero with the time in which it takes place, can only be based upon the assumption that the ratio of the time to the proper time (interval) between two points on any (curved) world line remains finite and different from zero But this assumption requires the consideration of non-linear transformations, and thus of the general Theory of Relativity

In order to put the so-called "Principle of Equivalence" into a slightly different form, we make the following statements

1 The world can be considered as a set of points which represent "event-particles"
2 The points can be ordered along "world lines" by means of a "relation of identity," which is given by the psychical phenomenon of recognition
3 A bundle of world lines can be considered as a single world line This is based upon the psychical judgement that they "belong together" This "relation of whole and parts" ("relation of class") permits us to consider the set of world points as four-dimensional
4 There are considered binary relations between different points, namely, "relations of cause and effect," which can be represented by the "lines of causality"
5 *It is possible to describe every physical phenomenon by using only the relations of coincidence, identity, class and causality*

These assumptions imply that we can construct a four-dimensional "graph" of universal history, graphs topologically equivalent not being distinguished by this definition The very meaning of the ether-question is Do the phenomena require a particular *metrical* system to which the universe must be referred? The reduction of the question to this form enables us to answer it at once and obviously in the negative For a topological transformation never can translate a "true" description of an observation into a 'false' one Relativistic physics has acquainted us with the new notion of the "metrical field" which is *apt to replace the old ether* as a carrier of electro-magnetic waves, so that it appears to be quite appropriate to reconcile "etherists" and non-etherists

Following a remark of Hermann Weyl ("Was ist Materie?", Berlin, Jul Springer, 1924, p 63) it is possible to reduce to rest simultaneously all bodies in the world (however they are moving relatively to each other) by means of a topological transformation Consequently there is no meaning in speaking even about relative motion of separate bodies, *e g* of the stars and the earth All we can say is that the earth moves relatively to the surrounding field, to the "star-compass" Here I would remark that even a relative motion of the earth to the surrounding field only has a meaning if the world is anisotropic around the earth for *a spacial isotropic field can always be considered as being statical*

The Miller effect shows us that rigid rotation does not leave the light-paths invariant, in other words, *that isotropy of the field and isotropy of the light-paths are not equivalent* If rigid motion *that is to say the metric field* is isotropic, then light-motion is not and vice versa Consequently the light-paths do not coincide with the minimal lines of the field Although the Theory of Relativity in its present form holds for this coincidence, relativism in general leaves open the possibility of light-motion differing from quickest motion (as has been stated by Prof Whitehead) Light only loses its exceptional qualities and quickest motion becomes an unreachable or at least unreached limit, not only for material, but also for electro-magnetic motion and in general for each form of motion which transports energy But instead of being contradictory to the idea of relativism this difference on the contrary agrees much better than the special Theory of Relativity with the modern view that matter and light are only gradually differing forms of energy

Until now it has been impossible to say whether the Miller effect is due to translational or to rotational motion In the first case the effect should vary periodically in time with the two periods of one day and one year, in the second case it should remain constant From the point of view of the field-theory of matter the second case would mean a statical anisotropy of the field, whereas the first case would lead to an anisotropy varying in time, namely, a turning around the world lines of terrestrial matter, the latter being supposed to be reduced to rest

In any case the Miller effect has shown us (according to a remark of Prof G Mannoury) that *the field, or the ether, or empty space, whichever you call it, plays an integrant part among the causal relations of physical phenomena and thus is not so very "empty" as it is supposed to be*

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Non reversible Transmission

ATTENTION has been directed to the possibility of non-reciprocal relations in the transmission of radio waves between two wireless stations (NATURE, by Prof E V Appleton and M A F Barnett, March 7, p 333, 1925) Such a possibility appears at first sight to be contradicted by the general reciprocal theorem which states that the E M F induced in A by unit current in B is equal to the E M F induced in B by unit current in A But this theorem rests on the assumption that all solutions are linear, and if this condition is waived, non-reciprocal relations are possible

In confirmation of this the following examples may be cited which may have some bearing on the observed fact that transmission from west to east (on long waves at night), for example, England to Australia, appears to be considerably better than in the opposite direction It should be noted that each of these are examples of "non-linear" effects In the first case, consider a slab of ionised gas, the ionisation being assumed to be maintained by some external agency, for example, ultra-violet or X-rays It can be shown that associated with this medium there is a critical frequency given by

$$n_0 = \left(\frac{e^2 N}{\pi m}\right)^{\frac{1}{2}}$$

where N = number of ions per c c (assumed for simplicity of one sign), e the charge, and m the mass of such ion Neglecting the effect of collisions, then for frequencies n_0 the medium is transparent, but for frequencies less than n_0 the slab acts as a perfect reflector even for normal incidence The physical reason for this is closely associated with the radiation pressure exerted by the electromagnetic waves on the medium Thus in the neighbourhood of n_0 the rate of increase of momentum of the ions (due to the E M forces in the wave) is equal to the rate of change of momentum in the waves, where these are supposed to be completely reflected, so that the wave is totally reflected by mechanical reaction against the moving ions

Consider now two radio stations A and B, one on each side of the slab If the frequency of the emitted waves is n_0 or less than n_0, neither station will be able to communicate with the other

Now suppose the slab of ionised gas to be moving from left to right with a velocity v So far as the slab is concerned, the frequency of the waves emitted by B will appear to be increased and those by A decreased The slab will be transparent to waves from B but not to those from A, that is, B will be able to communicate with A, but A will not be able to communicate with B Alternatively, we may treat the problem as an exercise in relativity with the same ultimate result

The other example is more complex and depends upon the existence of a steady magnetic field

A slab of ionised gas is again the mechanism by which the irreversible effects are produced But in this case we assume that the ions have a velocity of drift, say vertically downwards (in the direction of the Z axis), that the normal to the electric wave is in the direction of the X axis, say right and left, and that the steady magnetic field, Hy, is at right angles to both, that is, in the y direction

Under these conditions the electrons in the downward stream will be subject to two average forces, (a) a force at right angles to their velocity, and at right angles to the steady magnetic field Hy (this force will be in the X direction), and (b) a force due to the radiation pressure of the wave in the positive or negative direction according as the wave is moving from left to right or vice versa In the former case the two forces conspire in producing a motion in the ions, and in the latter, if Hy, V, and E are suitably arranged, they cancel The reaction of the ions on the incoming wave will then be different according as the wave moves from left to right or vice versa In the latter case there should be no work done by the radiation pressure on the ions, and therefore no loss of energy in the waves, in the former case work is done and a consequent loss of energy ensues

The amount of reflection will be different according as the wave approaches from the left or from the right, and an irreversible effect is produced

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The Future of the British Patent Office

DR MARTIN's courteous letter in NATURE of September 12 calls for some reply, for although on questions of history we are in the main in agreement, yet when, as he says, we come to close quarters, he fails to reproduce my argument quite accurately

Dr Martin says, for example, that my two basic principles are not necessarily antagonistic This I asserted, but said that for administrative purposes they could not be treated as co-equal, for the two types of administration would differ fundamentally If the institution of new industries is the proposed object of our patent law, as I think is clearly the case from the provisions in the 1919 Act, the application form would have to be altered The applicant would be required to affirm, as he used to do that he was in possession of an invention which was not in use in the kingdom, and which it was his intention to introduce at the earliest opportunity The official search certificate would state to what extent if at all, the applicant's claims appeared to conflict with descriptions or claims in British specification of patents in force or with pending applications of concurrent or prior date The case of applications under the International Convention would have to be reconsidered The preferential treatment of the foreigner has always seemed to me contrary to the policy of our patent law The validity of patents when granted would depend—(a) in cases where commercial working was shown upon the state of the art in the kingdom at the date of the letters patent, and (b) where the patentee relied upon his specification, upon the state of public knowledge in the kingdom In the latter case the patentee would be bound to show good reason why his patent had not been put into practice

It is not, therefore, correct to say that since perfection in practice cannot be attained I recommend no search at all My view is that, where one inventor fails, others should be encouraged to try again For this purpose the official search must be brought into harmony with the revised statutory definition of novelty

The anonymous letter which I quoted was intended to show that the world-wide search was breaking down and that, in the opinion of one well informed in American practice, a radical change in the statutory definition of novelty was the only solution of the difficulty All bibliographical evidence tends to support his opinion

Again, Dr Martin does not agree with the thesis "that when security is at its highest, restraining power is necessarily at its lowest"—but my statement was "that as a general rule when security is at its highest the other factor will be little or none at all" The percentage, however, of really great inventions which pass scathless through the fire of the examining staff

is very small, and their commercial value depends, not upon an examiner s report, but upon the homage paid by all men of science to the path-breaker who opens a new road of research for the benefit of mankind

E WYNDHAM HULME

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THE present Patent Office search, extending back for fifty years for novelty, is as Mr Hulme says (NATURE, September 5, p 356) really useless, and a fuller search ridiculous To the inventor it is irritating , and it is of little value to the manufacturer, for before he gives a high price for the monopoly or spends much in adapting his plant and designs for using it, he, as a prudent man, will want something more

Of course the granting of letters patent for overlapping existing protected inventions should be avoided, but that is all that is required It should be open to any one to use the invention, or part of it, if he can show that it, or the part of it he is using, is old in the sense that it has actually been used , and a patent should not be invalidated because it, or part of it, has been described or figured a long time ago and forgotten until rediscovered by much "fever of the brow" and expenditure of time of the searchers

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Analysis of the Arc Spectrum of Copper

STARTING from the constant frequency differences in the copper arc-spectrum, suggested by Rydberg, I have recently been able to deduce the values of a large number of new terms of that spectrum My paper in the *Philosophical Magazine* (vol 69, p 951) has shown that copper gives a spectrum which is far from simple, and the further data now obtained show even greater complexity

The new terms can be divided into two sets, those of the first set all being positive and combining with one or both of the known abnormally high *d*-terms This set contains several terms already used in my paper The inner quantum numbers are of course definite except in those cases where combinations with both d_2 and d_3 occur The second set of terms consists altogether of negative terms which each combine with three or more of the first positive set, giving lines the wave-numbers of which differ from the calculated by not more than two-tenths of a wave-number Altogether, about 125 lines are accounted for by these new terms The inner quantum numbers of the negative terms can be deduced, though with some uncertainty, from their combinations with the positive terms The values of the terms are as follows, the probable nature and inner quantum numbers being given with each

5026 2 ($j=4$)	−95 2 (3)
5656 7 (2 or 3)	−640 2 (p'_3)
6278 2 (4)	−1276 4 (p'_1)
15709 8 (2 or 3)	−8690 0 (3)
17345 2 (4)	−8819 7 (3)
17763 9 (p_2)	−8870 1 (3)
17901 8 (d'_3)	−8960 1 (3)
18581 9 (d'_2)	−9619 1 (p'_2)
18794 1 (4)	−9708 6 (3)
20005 5 (s'_1)	−9758 9 (p'_3)
20745 2 (2)	−9785 0 (3)
21154 7 (4)	−10890 7 (p'_2)
21364 3 (p_1)	−10996 5 (p'_2)
22194 0 (p_2)	−14722 0 (5)
23289 4 (4)	−14760 1 (5)

As yet I have been unable definitely to arrange many of these terms together either as doublets or quartets It is evident however, that quartets are involved The difficulty arises partly from the large separations which are common in the copper spectrum and make estimations of relative intensities of lines of a multiplet uncertain The complete analysis should afford tests of the theory of negative terms suggested by Russell and Saunders in their recent paper on the calcium spectrum

Dr L A Turner of Harvard University, has recently suggested to me a possible explanation of the abnormally large inverted *d*-terms in the copper spectrum 51105 5 (d_3) and 49062 6 (d_2) based on considerations brought out in a paper by Pauli (*Zeit fur Phys* 31, 10) If we consider these terms as being due to the displacement of an electron from a 3_{32} or a 3_{33} group to the 4_{11} group, which is then closed, the atom might be considered as in a *d* state The inversion would be accounted for since the 3_{33} position is of higher energy than the 3_{32} position Moreover, the formula $\Delta\nu/R=(z-s)^4/2\ \alpha^2/3^4$ (Sommerfeld, p 449) should yield a screening constant s approximately equal to 13 0, which is the value given by the separation of M_{32} and M_{33} for atoms of high atomic number The value found is $s=13\ 6$, which is suggestively close, considering the large extrapolation, and the approximation involved in considering the two electrons in the 4_{11} ring as having the same effect in the two cases

A G SHENSTONE

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August 3

Dispersal of Butterflies and other Insects

IN the issue of NATURE for September 5, Mr E P Felt in his interesting article on the "Dispersal of Butterflies and other Insects" says "It is quite possible that some insect movements are direct responses to a migration impulse ' As bearing on this point, the following incident which occurred some years ago, may not be without interest

I was walking through a field of standing wheat that was growing on the Downs near Walmer, Kent the sun was just below the horizon, the air warm and still, when I noticed that moths were rising from the wheat and flying vertically upwards until they were lost to sight On closer inspection, I found that vast numbers of the silver Y moth (*Plusia gamma*) were buzzing about among the wheat stems and that individuals were continually leaving their fellows and taking the upward flight Although the larva of *P gamma* will feed upon a great variety of low-growing plants, such as nettles, docks, and so forth it is most unlikely that such numbers could have found sustenance on the weeds that might be growing in a fairly well kept wheat field and the inference is that the moths had assembled among the wheat stems with the purpose of migration, and by their upward flight were seeking a favourable wind current to assist them in their journeyings in the upper air

The incident, moreover, is not an isolated one, for Richard South describes a similar happening (*Entomologist*, 1880, p 42) which he had witnessed in the Isle of Wight the insects were, he believes, the same species, but in his case they were rising from furze bushes

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Fifty Years' Evolution in Naval Architecture and Marine Engineering[1]

By Sir ARCHIBALD DENNY, Bart

AFTER Watt's invention of the separate condenser, many years elapsed before the next considerable step in marine engineering—the introduction of the compound steam-engine This was natural, as steam pressures were too low to make compounding profitable The first record I can find of compounding was John Elder's *Brandon* in 1854, and progress thereafter was not very rapid, but when I began my apprenticeship, in 1876, the old box boiler had been replaced by the now highly appreciated Scotch circular return-tube boiler, supplying steam to two-cylinder compound engines at about 60-lb pressure It was not then found profitable to carry more than about 25 in of vacuum Auxiliary machinery was almost non-existent

As to types of marine engines—in the Navy, for protection reasons, horizontal machinery was not uncommon, while in the mercantile marine, for screw ships, the vertical type was practically universal In paddle-steamers for river and coast service, of which there were many, the beautiful oscillating engine, which had the advantage of taking up little room lengthwise, was still built, but the diagonal engine was more common, either with single cylinder and haystack boiler or compound two-cylinder

Returning to sea-going vessels, the *Propontis*, a vessel built in 1864, was re-engined at Fairfield with triple-expansion three-crank engines designed by the late Dr Kirk in 1874, with boilers working at 150-lb pressure, but the boilers, Rowan's water-tube, proved unsatisfactory, and in 1876 new Scotch boilers of 90-lb pressure were fitted The first really successful triple-expansion three-crank job, the *Aberdeen*,[2] was built in 1880 by Robert Napier and Sons, and fitted with engines and 125-lb pressure boilers designed by Dr Kirk The re-engining of the *Propontis*, however, marked the opening of a new era, which only developed slowly at first, due in some measure to the then rules for the thickness of the boiler shells and furnaces

The next great step was the introduction of the Parsons turbine None can forget the tremendous interest created by the appearance of the 34½-knot 100-ft *Turbinia*, at Spithead Review in 1897 I felt that here was the engine we had been looking for to use in fast cross-Channel work, and it was a great gratification when Sir Charles Parsons and Captain John Williamson arranged with my firm that we should join in a venture to build and run a Clyde river-steamer fitted with turbines, the *King Edward*, put on service in the spring of 1901, was the result—the first commercial turbine Before that, however, in 1898, the Parsons Marine Steam Turbine Company received an order from the Admiralty to build the *Viper*, and Messrs Armstrong, Whitworth, on their own account, built the *Cobra*, engined by Parsons Both of these were torpedo-boat destroyers, and the *Cobra* was purchased by the Admiralty

Following the *King Edward* and *Queen Alexandra*, the *Queen* for the Dover-Calais service and the *Brighton* for the Newhaven-Dieppe service were the first cross-Channel turbine steamers put in service in 1903 They also were most successful, and the turbine as a commercial engine was fairly launched, a great tribute to the genius of Sir Charles Parsons and his courage in overcoming the many initial difficulties The decision, taken early in 1905, to fit turbines in the large Cunarders *Lusitania* and *Mauretania*, built by Messrs John Brown and Messrs Swan and Hunter respectively, was a very bold and momentous one fully justified by the success of these vessels, it was a tremendous step to take from the smaller vessels already built and tried, to these leviathans crossing the stormy Atlantic In 1905 the Admiralty also decided on the general introduction of turbines in all classes of warships

The earlier turbines were all fitted as direct drives and hence to vessels of fairly high speed, when the revolutions were not too low to spoil the efficiency of the turbine or so high as to spoil the efficiency of the propeller But from the first it was felt that some means of gearing down the propellers was absolutely necessary, Sir Charles Parsons' conversion of the *Vespasian* in 1909 from reciprocating to geared turbine gave the answer required and marked another new era

In 1897 Dr Diesel began developing his internal-combustion engine, depending for the ignition of the charge of heavy oil not on electric sparks, hot tubes, or bulbs, but on the heat generated by compressing the air charge Immense developments have taken place in this direction Initially the greatest progress was made with this type of engine on the Continent My information is that the first successful ocean-going motor-ship was the *Vulcanus*, built in 1911 by Werkspoor of Amsterdam for the Anglo-Saxon Petroleum Oil Co, while the first completed in Great Britain was the *Jutlandia*, built in 1912 by Barclay, Curle and Co

While Great Britain may have been slow at first in taking up the Diesel, certain types—such, for example, as the Doxford and the Cammell Laird-Fullagar—are purely English Another purely English one (which, being a combination of steam and oil, is exceptionally interesting) is the Still engine, of which that on the *Dolius*, built by Messrs Scott of Greenock for Messrs Alfred Holt and Co of Liverpool, has been successful The first double-acting four-stroke cycle marine engine in Great Britain was developed at the North-Eastern Marine

While the turbine developed from the fast passenger-vessels direct driven, to the slow cargo-boat with gearing, the Diesel started in the slow cargo-vessel and is developing towards the faster liner, of which the *Aorangi* of the Union Steamship Co of New Zealand, built this year by the Fairfield Co, is, at the time I am writing, the most notable example

The foregoing is the briefest of brief outlines of the changes in the main engines of ships, but the development in auxiliary machinery has been of tremendous importance and extent In no direction has advance been greater than in the use of electricity on board

[1] From the presidential address delivered at Southampton on August 27 before Section G (Engineering) of the British Association

[2] Messrs Augustine Normand, Havre have now proved to me that Benjamin Normand fitted a Seine passenger steamer with triple expansion engines in 1871 and fitted at least two more successfully before 1874

ship In 1884 the *Arawa* and *Tainui* were fitted with incandescent electric lighting with stand-by oil lamps The total power used was about 30 horse

What developments there have been since then! Instead of the feeble 20 kilowatts, hundreds of kilowatts are now in use on a vessel of the same size, and the current is used not only for lighting, but also for ventilating, local heating, cooking, and for driving small machinery of all kinds, including frequently many of the important engine-room auxiliaries, in fact, in some vessels practically all the auxiliaries are driven by electric motors

The fuel consumed in developing the power of these auxiliaries is now such an important proportion of the total fuel consumed that their design and installation is becoming, to a certain extent, a separate branch of engineering To show the importance of a thorough study of this auxiliary-power question on board ship, I have been informed that in a large intermediate passenger-ship the consumption of fuel for auxiliaries is reported as exceeding 10 per cent of the total consumption, and that 15 per cent or more is not uncommon in some other vessels

In types of boilers the development has gone from the old box form with safety valve opening inwards to prevent them collapsing when cooling, to the well-known and most extensively used Scotch marine circular boiler with return tubes But always there were inventors working at the water-tube boiler, and several were constructed which proved successful The Haystack was an early example, and those of Yarrow, of Thornycroft, and of Babcock and Wilcox may be named as types In my own experience Yarrow and Babcock have each been used in fast cross-Channel steamers with absolute success, and, apart from the great user of water-tube boilers, the Royal Navy, water-tube boilers are being used increasingly in oversea merchant-ships For land stations they are in great demand, fitted with mechanical coal-stokers or with pulverised coal or oil firing, in units of such enormous size and with steam pressure so high that steam drums have been built and used 34 ft long, 4 ft internal diameter, and 4 in thick Shall we see such boilers on board merchant-ships? I have no doubt we shall, though I would not care to express any opinion as to the ultimate highest steam-pressure which will be used, but 500 lb is in sight

Superheating of steam was early recognised as a very desirable thing, but it took many years to produce a reliable superheater, and then there were lubrication and other difficulties in reciprocating engines which had to be surmounted In the case of turbines certain of these difficulties were non-existent, and turbines are peculiarly suited to the use of superheated steam Another economical advance is pre-heating of air, which is now being pushed much further than ever, but with which the name of Howden will always be associated Stage feed-water heating is also being very fully carried out

Fuel-oil firing of boilers has been very largely adopted in steamships, with a marked gain in speed and, when oil is marketed at certain figures, with economy of cost as compared with coal, not only on account of its relatively smaller weight consumption, but also on account of the reduced crew required and the more regular speed obtained, hence shorter time at sea But in considering the relative advantages of steam- and motor-driven ships one must remember that an oil-fired steamship, in the event of oil soaring in price, may be converted to coal-burning, while in a motor-ship the owner has not that option

As to powers developed by the main engines in any one steamship, from the 2000-3000 I H P in good class passenger-ships of 1875 to the 75,000 I H P we now find in the most powerful merchant-ships, or more than 140,000 in naval vessels, is a stupendous step

Turning now to the ship herself and to naval architecture I crossed to the United States to see ships' behaviour in heavy weather in December of 1882 in the *Parisian*, of the Allan Line, and returned in the same month by the *Alaska* The latter was the "crack ship" at that time, and was 500 ft long, the former was 440 ft long, and they were considered enormous ships The *City of Rome* was 560 ft, but was not so fast as the *Alaska* They were all single-screw ships

Mr Foster King read a paper at Philadelphia, U S A, in 1912, in which he divided ships into three groups

(*a*) Atlantic passenger-ships (the longest ships)
(*b*) Passenger-ships on all other routes
(*d*) Cargo-ships

He obtained from the owners and registry books particulars of thousands of ships, and plotted them on diagrams on a base of years and with lengths of ships as ordinates From these diagrams he concluded that the growth of "the largest ships in the world" might be fairly represented by straight lines in each group, that group (*a*) ships grew at the rate of 66 ft in ten years, and group (*b*) 50 ft in ten years He observed, however, that after 1897 special vessels in (*a*)—namely, the fast Atlantic ferry—grew much more rapidly, at the rate of 150 ft in ten years For cargo-vessels (*d*) the rate of growth was about 30 ft in ten years

Taking Mr King's (*a*) line, in 1875 the longest ship was about 475 ft, while, owing to the above-mentioned offshoot of the Atlantic ferry-boats, in 1912 it was round 900 ft The *Majestic*, the present longest ship, is 915 5 ft Reading from the (*b*) line, in 1875 the longest ship was round about 425 ft In 1912 it should have been 610 ft, but was actually 570, and he remarks in explanation that "one of the usual pauses was occurring" The *Oronsay*, on the Australian trade, is the present longest (*b*) line boat at 633 6 ft The *Empress of Canada*, on the Pacific, is 627 ft long As to cargo-ships—general traders—in 1875 a 3000 dead-weight carrier was a large ship, the more usual size was 2000-2500 tons Now, 7000 to 8000 is the ordinary size, 10,000 is not uncommon, and many exceed that latter dead-weight

In dealing with the growth in breadth of ships, Mr King remarks that about 1875 the fashion in passenger-ships was about ten beams to length, but that after 1880 proportionate breadth became rapidly greater An analysis of data available to me confirms this view, and that it is not now uncommon to find a proportion of eight beams to length, or even seven and a half

The draught increased along with the increase in length, and the ports were constantly improved in depth, while new dry docks and floating docks kept

pace. Perhaps no better example can be given than the port of Southampton with its "longest in the world" floating dock.

Increase in draught is usually the most economical way of increasing carrying capacity or speed, hence the desire of naval architects for ample depth in ports and canals. When a curve of draught for the same proportion of depth to length is drawn with length as a base, it is seen at once that draught is proportionately less for the longer ship, and, as Lloyd's original tables were based on the current practice of the day, it is to be presumed that practical sea experience is responsible for this. Mr. Foster King's 1912 analysis of practice, as might be expected, shows the same thing. In the early 'eighties, however, experience was limited to about 400 ft. in length, and subsequent experience has shown that these and the longer steamers might safely be loaded deeper than the original rules contemplated.

Let us now turn to consider the change in the provisions for the comfort and convenience of the passenger. In the earlier days of steamships the first-class were in a poop, and the accommodation was very much in the style of the old sailing-ship—a row of cabins at each side with the dining-tables in the centre. There was an open-ended bridge and a forecastle, where the officers and men were accommodated. Gradually, in later vessels the poop joined the bridge, and then the bridge joined the forecastle, and the vessels became awning-deckers or spar-deckers. Then in later ships forecastles again appeared, and midship houses developed into bridge-houses; then poops were fitted, to go once more through the same programme. Thus, as size increased, deck after deck has been added, until in the largest vessels the old names of bridge, upper, main, lower, and orlop no longer suffice, nor are they truly descriptive, and the decks are lettered A, B, C, D, etc.

The navigating bridge of a modern high-class steamer is an inspiring sight, with gyro compass probably fitted with an automatic quartermaster, "tell-tales" from the engine-room giving the revolutions of the engine and the direction of turning, similar "tell-tales" to the rudder head showing the angle of the tiller; the steering gear, now fitted aft, is controlled by a "telemotor," first invented by A. B. Brown of Edinburgh; wireless rooms, wireless direction-finder, and it may be underwater microphones for finding the position from underwater land bells; probably an outfit of telephones communicating from the bridge to the various chiefs of departments; automatic indicators showing the water in all holds and ballast tanks, and means for closing all water-tight doors below deck in event of fog or collision.

Returning for a moment to the cargo-steamer—I have already dealt with the growth in size, but there are many other changes in these ships. Sails having practically disappeared, we find the place of masts taken by Samson posts and gantries; indeed, very many modern vessels, built for special trades, look more like a building berth in a shipyard than a sea-going steamer. The equipment has much improved both in the engine-room and on deck, and cargo appliances are quite different. But an important change is in the question of fullness of block. For a considerable time the shipowner seemed to think in terms of £'s per ton dead-weight. This inevitably led to fuller and fuller blocks, until 0.83 was not uncommon; result—a low speed and a great uncertainty as to date of arrival at a port if any bad weather was encountered. Of course, block must be coupled with length, for the longer ship may have a fuller block, but round 400 ft. a block of 0.76 is now much more fashionable, with the result that, while the dead-weight lifted at one time on the same length of vessel is less, yet the higher speed and the greater regularity of time on the voyage, due to the ability to keep up a reasonable speed in bad weather, make the finer vessel a more economic proposition.

A most interesting and important type of special trader is the bulk-oil carrier or oil-tanker, which has developed quite a special technique in design, construction, and fastenings. Originally oil was carried in cases, but, starting with quite small bulk-oil carriers, we now find oil-tankers among the mammoth dead-weight carriers of to-day. Bulk grain, coal, and especially ore carriers, involve also quite special considerations in stability, and strength to resist concentrated loads in the last mentioned, of which type the highest development is to be seen on the Great Lakes of North America.

I have not referred at all to the tremendous changes which have taken place in the Royal Navy; that in itself would take more time than I have at my disposal. In main engines, however, the lines of development have been much the same as in the mercantile marine, while in the vessels themselves their purpose is so different that no comparisons can be drawn. But their design has not been without its influence on the merchant-ship in many details, and there are several directions in which the work at the Admiralty has had a commanding influence on naval architecture in Great Britain.

We may now turn to the technical training of the marine engineer and naval architect. Until the founding of the John Elder chair of naval architecture and marine engineering at the University of Glasgow, the technical education available to apprentices in private works was provided practically entirely by evening classes under the South Kensington Science and Art Department. Many of those men who, for at least a generation, were responsible for the great strides made in the technical efficiency of the twin industries received their professional education at these classes. These classes are still doing good work. Of course even before special chairs were established, B.Sc. courses in engineering were open to students, but only a few bursary or moneyed students could take advantage of them. For generations the Royal dockyards have taken care of the technical instruction of their apprentices, and schools for their instruction were, and are, at work in every dockyard. I can only stop to note the foundation of the Royal School of Naval Architecture and Marine Engineering at South Kensington. The best students from each dockyard were sent there for the first time in 1864, to receive a training in higher science and mathematics of a severity unmatched in any college.

Without proper technical education an efficient corps of designers and of research workers could not be main-

tained, and considerable and important has been the research work guided by the Admiralty, by our technical institutions, by Lloyd's Registry, and by many private firms and individuals

In research, to no two men are we more indebted than to Dr Wm Froude and his son, Mr R E Froude, for the experimental work done by them on ships' resistance and screw propellers The British Association in 1868 appointed a committee to consider stability, propulsion, and sea-going qualities of ships, and of that committee Dr Froude was a member, the others being Merrifield, Galton, and Rankine The committee recommended experiments on actual ships, but Dr Froude dissented and gave it as his opinion that model experiments were of value and were much cheaper to carry out, describing some he had made in 1867 In 1868–69, on the suggestion of Sir Edward Reed, then Chief Constructor, the Admiralty agreed to bear the cost of the construction and the working costs of the tank at Chelston Cross, Torquay This tank started work in 1871, Dr Froude acting as chief, and he gave his services gratuitously as long as he lived On his death Mr R E Froude took over charge, continuing and expanding his father's work The results were freely communicated by him, with the full consent and encouragement of the Admiralty, to the Institution of Naval Architects in a series of valuable papers The Torquay tank was ultimately dismantled and transferred to Haslar, where the good work is continuing

There are now, besides the Government tank at Haslar, the following Froude tanks in Great Britain, in the order of age—Denny (Dumbarton), Brown (Clydebank), William Froude (Teddington), Vickers (St Albans), and Parsons' have also a smaller open-air tank at Newcastle that is six, and there are in Italy, Germany, France, Sweden, Russia, Austria, Japan, and the United States other eleven, a total of seventeen, and it may be claimed that tanks have had more far-reaching effect on design than any other means of research

Yet, when one considers the research carried out on ferrous and non-ferrous metals, that claim may be disputed Time fails me to do more than indicate to you the history of mild steel While steel had been used in shipbuilding at an earlier date, our present material came into daily use in merchant-ship building in the late 'seventies of last century, and I can remember the interest taken in the *Buenos Ayrean*, the first steel Atlantic ship, built in 1879 With the considerable reduction in scantlings allowed by the Classification Societies, mild steel rapidly displaced iron in ship construction But still we were warned that it was unreliable if worked at a blue heat, and some failures were recorded Further improvement in manufacturing methods, however, finally gave us a material of great reliability and easily worked The limits of 28-32 tensile strength and 20 per cent extension in an 8-inch specimen have been standard now for many years, though steels of greater carbon content and higher tensile strength have been used and as Young's modulus is practically the same for all ordinary carbon steels, these higher tensile steels could be used in conjunction with milder steels without disadvantage But there is now another mild carbon steel on the market which has a higher elastic limit, the use of which is just beginning, it is claimed that it will ensure further advantageous developments in reduction of weight of hull

Sir Robert Hadfield's invention of high-manganese steel gave a fresh impetus to research in ferrous alloys, and now we have alloys of nickel, chromium, vanadium, tungsten, and other metals, each with its own special use either in construction of ships and their machinery or in the machine-shop for tool-steel, thus still further advancing the science and art of shipbuilding and marine engineering

Other powerful factors in the development of the merchant marine were the Board of Trade, the Classification Societies, and the technical institutions and societies

The Board of Trade is charged by statute with the duty of seeing that ships are safe and sufficient for navigation The individual surveyor is legally responsible, and it is he who must certify safety and sufficiency, but, for co-ordination purposes, there is a Consultative Branch at Whitehall which issues "Suggestions and Instructions" to the surveyors as to how they should carry out their duties These "buff books" have in practice largely the same effect as the rules and regulations of the Classification Societies

Practically every maritime nation has a Registry or Classification body or bodies of its own, but in Great Britain that type of organisation has been earlier and more fully developed than in other countries Lloyd's Registry has a world-wide name and has had a profound influence on design not only in this country but also all over the world This leads me to speak of standardisation in shipbuilding and engineering The first work of the B E S A, when it was established in 1901, was the standardising of ships' sectional material Order was thus brought out of chaos, the number of standards, sections of all kinds and sizes, was fixed at 175, and the steelmakers reported that a saving of at least 5*s* per ton was the result A revision in 1918 reduced the standard sections to 115 A recent piece of work of the B E S A is the standardising of the tail-shafts of ordinary cargo-vessels, which standards may also be applicable to many passenger-ships The taper of the shaft to take the propeller boss is also fixed It can easily be seen what a saving this would mean in the case of damage at a distant out-port, where, were these standards adopted, only a few spares need be kept, or even the spare of one steamer could be used for another with the same diameter shaft, and thus in the case of damage the present long delays in an out-port waiting for replace parts would be avoided

The influence of the Institution of Naval Architects on the progress of design cannot be exaggerated Founded in 1860, there has been a constant stream of valuable papers read and discussed at the annual meetings, naval architects and marine engineers were glad of the opportunity of presenting the results of their experience to their fellows and of profiting by the discussion of their ideas Now there are all over Great Britain—at Liverpool, Newcastle, Southampton, Glasgow, and other centres—similar institutions, contributing to the advance of the science by their meetings and published transactions

Radiometric Determination of the Temperature of Mars in 1924

By Dr. W. W. COBLENTZ, Bureau of Standards, Washington, D.C.

THE main problem in the radiometric programme of 1924 at the Lowell Observatory, as stated in the article in NATURE of September 19, p. 439, was the measurement of the radiation from Mars. For this purpose most of the measurements were made at the 640-inch focus of the 40-inch Lowell reflector, which gave an image of the disc of Mars about 2 mm. in diameter. The receiver of the vacuum thermocouple was 0.23 mm. in diameter, or about ⅑ of the diameter of the disc of Mars at opposition. This permitted the isolation of small areas on the disk of the planet and revealed hitherto unobserved and perhaps unexpected temperature conditions.

By means of a series of screens of water, quartz, glass, and fluorite, the radiation emanating from a planet, *e.g.* Mars, was separated into spectral components and the radiation intensities determined in the spectral regions of 0.03 to 1.4μ, 1.4 to 4.1μ, 4.1 to 8μ, 8 to 12.5μ, and 12.5 to 15μ. In this paper the ratios of the spectral components of the planetary radiation at 8 to 12.5μ and at 12.5 to 15μ (A : B) are of special interest. The radiometric work was carried out in collaboration with Mr. C. O. Lampland, and the complete results are given in the June and July issues of the Journal of the Franklin Institute.

In view of the conflicting opinions regarding temperature conditions on Mars, it was desirable to reduce the radiometric data by various methods and also to have someone not connected with the work to make some of the calculations. The writer therefore submitted to Dr. D. H. Menzel a considerable portion of the observations obtained in 1924 for calculation, thus supplementing the work of 1922, as mentioned in NATURE of September 19.

Martian temperatures were derived by the following methods: (1) by the fourth power law of black body radiation (Menzel), using Russell's formula and the observed Martian water-cell transmissions (W.C.T.'s in Table 1); (2) by the law of spectral radiation and the ratio of the Martian spectral radiation components, A : B; (3) by plotting Very's observed lunar temperatures against the observed lunar spectral radiation components, A : B, and extrapolating to the observed ratios of the Martian components; (4) by calculating the lunar temperatures (Menzel) from the lunar water-cell transmissions, using the fourth power law, plotting these temperatures against the observed lunar spectral radiation components, A : B, and extrapolating to the observed ratios of the Martian spectral radiation components; and (5) by plotting the lunar temperatures (which were obtained by calculation from the lunar water-cell transmissions, using the fourth power law) against the observed lunar water-cell transmissions and extrapolating to the observed Martian water-cell transmissions. (A more complete discussion is given in the *Astronomische Nachrichten*, June 1925.)

TABLE 1.—MARS: COMPARISON OF TEMPERATURES ON THE APPARENT CENTRE OF THE DISK AS OBTAINED BY VARIOUS METHODS.

Date 1924	Water cell Transmission (W.C.T.)	Spectral Components (A : B)	Temperatures °C. Method: Black Body 1 Menzel (W.C.T.)	Black Body 2 (A : B)	Moon 3 Very (A : B)	Moon 4 Menzel (A : B)	Moon 5 (W.C.T.)	Mean	Region on Mars
Aug. 6	33.5	41.7	−1	12	14	12	2	8	Syrtis Major
14	30.5	41.3	9	10	13	11	16	12	Mare Sirenum
15	32.4	43.1	5	21	18	14	8	13	,,
18	31.1	38.6	4	−5	8	7	13	6	,,
21	32.5	40.7	3	6	12	10	6	7	,,
21	34.9	39.1	−5	−3	6	8	−7	0	Bright region north of Mare Sirenum
23	32.8	36.6	2	−20	3	4	4	−1	,, ,, ,,
25	33.7	38.3	−7	−8	7	6	2	−1	Bright region north of Beak of Sirens
28	31.2	50.0 ?	4	55 ?	32	24	12	18	Solis Lacus. Poor seeing
Sept. 11	30.8	47.8	1	45	26	20	15	22	Syrtis Major
13	29.6	39.3	6	−2	10	8	22	9	,,
13	25.1	55.8 ?	22		42	32		32	,, 18.4 foot focus
14	29.3	46.4	6	40	22	18	25	22	Mare Cimmerium

In addition to these calculations, planetary temperatures were inferred from comparisons with the earth, in which it is shown that the temperature of the solid surface of Mars would be expected to rise almost as high as that of the earth. In fact, with much clearer skies and with less air convection in some of the darker places on Mars, especially in the temperate and in the frigid zones, where the insolation is so prolonged, the temperature should be considerably higher than observed on similar regions of the earth.

The temperatures derived by these various methods of reducing the data are in good agreement and indicate conclusively that the equatorial temperature of Mars, at perihelion, was considerably above 0° C. When one considers the difficulty in establishing the temperature of a terrestrial object within 10° C., it seems truly remarkable that these various methods appear to be so close in agreement in indicating that the temperature

of Mars rises above 0° C. This is an extremely important deduction, for the possibility of vegetable life on Mars depends partly upon the question of temperature conditions.

A weakness in the method of using the spectral components is owing to the fact that the spectral range of the planetary radiation is narrow, and the spectral transmissions of the atmosphere and of the fluorite screen at 10 to 11μ are not known with sufficient accuracy to determine the temperatures to better than 10° C. However, it is a new and an independent method for obtaining temperature levels.

Ordinarily it would be considered sufficiently close to have determined the temperature level to within 10° C. However, in the present problem the temperature estimates range about 0° C., and the question at issue is whether the average estimates place the value somewhat above 0° C., for the question of the possibility of vegetation on Mars depends partly upon this temperature estimate. While the results obtained by this method give a wider range of temperatures than the other methods, its usefulness in supplementing the other methods seems evident.

The dark regions were found to be hotter than the bright regions; also the east limb or sunrise side was observed to be cooler than the west limb or afternoon side of the planet. The temperatures of the bright areas range from −10° to 5° C., while the temperatures of the dark areas range from 10° to 20° C., or perhaps even higher. The average temperature of the apparent centre of the disk, including the bright and the dark areas, was found to be about 15° C., verifying the estimate of 10° to 20° C. based upon the radiometric measurements of 1922. There was but little seasonal change in temperature (average 14° C.) on the centre of the disk during the six weeks from August 1 to September 14. While the measurements were in progress it was winter in the north polar regions. Under these conditions the temperature of the irradiated north polar region was down to −70° C., or perhaps even lower, and continued at this temperature during the course of our measurements. Similar temperatures occur in our arctic regions during the winter. On the southern hemisphere it was early summer, and the temperature of the south polar region, as observed through the overhanging atmospheric mantle of mist or perhaps ice spicules, was −60° C. However, in view of the fact that it was the summer season, with melting snow and a receding polar cap, it is reasonable to assume that the temperature of the solid surface at the south pole was up to 0° C. The complete paper by Coblentz and Lampland in the Jour. Franklin Institute (June and July 1925) gives data on climatic conditions on various parts of the surface of Mars: (1) the bright and dark regions on the centre of the disk; (2) the east and west limbs; and (3) the north and south polar regions.

To the writer the apparent temperature of −60° C., as measured through the water cell during the early Martian summer in the south polar region, is not inconsistent with the commonsense interpretation of the visual observations (receding polar cap, melting ice) indicating a temperature up to 0° C., but is a remarkable verification of the presence of an atmosphere containing a mantle of ice spicules or perhaps water vapour ("mist"), which prevents the escape of planetary radiation from the solid surface. It is to be noted that our interpretation of planetary temperatures is based upon the radiation of wave-lengths 8 to 15μ which emanates from the planet. Evidently this overhanging mantle is of considerable extent and is perhaps in the form of a thick mist or fog which is opaque to these wave-lengths. For it is well known that the highly attenuated water vapour in our atmosphere is quite transparent to radiation of wave-lengths 8 to 15μ, whereas mist and fog prevent the transmission of infra-red rays of long wave-length.

The temperature of the south polar cap changed but slowly during July and August. However, in September the temperature began to rise rapidly, and by October the water-cell transmissions decreased to 30 per cent. or even lower, indicating a temperature of 6° C. (true temperature about 15° C.). This is extremely interesting in view of Rev. T. E. R. Phillips' recent paper on this subject (Mon. Notices R.A.S., 85, p. 179, 1924), in which micrometric measurements are given showing that the melting of the snow proceeded slowly during July, but that the cap diminished rapidly in size during August and September, and became very small in November.

This rapid rise in temperature of the south polar region from −60° (the temperature of the isothermal layer of the polar canopy; 0° C. if interpreted from the visual observations of the receding cap of melting ice) in July to 10° C. or even higher at the Martian summer solstice (on October 5) is perhaps one of the most important results of this investigation. From a consideration of the prolonged insolation on the south polar region, such a temperature rise is to be expected.

On the west limb the observed temperature was −2° to −8° C. at the beginning of August, when there was a small dark phase. When there was no dark phase on the west limb the temperatures ranged from 0° to 6° C.

Perhaps the most interesting series of measurements relate to the east limb or sunrise side of the planet. During the first part of August, the east limb was irradiated for an hour or more before turning into view. Under these conditions the observed temperatures of the eastern limb range from −10° to −20° C. At opposition, August 22, when there was no dark phase, the temperature was down to −45° C. At the conclusion of the series at the 53.3 foot focus, on September 12, when the dark phase was barely perceptible on the east limb (illuminated surface 0.976), the temperature was −60° C. How much lower the temperature falls, and whether this very low temperature is owing to setting the receiver on the atmospheric envelope, remains to be determined.

From the low temperatures recorded at the poles, and the small atmospheric envelope, it appears that the temperature of the night side of Mars may fall below −70° C.

This study of the seasonal changes in temperature, especially of the southern hemisphere of Mars, was continued late into November by Mr. Lampland, using the same radiometric equipment and galvanometer employed by us during the preceding months. He reports that the water-cell transmissions of the radiation from the north polar region continued unchanged at

70 to 80 per cent, indicating a temperature of about $-70°$ C, as was to be expected with winter on this hemisphere

On the other hand, the water-cell transmissions of the radiation from the south polar region decreased from the high value observed in the early part of September to 30 per cent, or even lower, in November and December, indicating a temperature of 10° to 15° C, or even higher Granting that some ice still remained at the pole, there would be a temperature gradient for which a correction should be made On this basis, the water-cell transmissions would be still lower and the temperature of the south polar region would be higher than indicated by these measurements

The observed high surface temperatures on Mars may be accounted for on the assumption that these dark areas contain vegetation having the properties of the tuft-forming grasses of our high prairies, and the tussock mosses and lichens of our dry tundras, which have a high absorptivity for solar radiation and a low thermal conductivity The assumption of the presence of such a type of vegetation is in harmony with the visual observations, which show changes in the colouring of the dark areas with changes in the seasons, and it is in agreement with the lower intensity of insolation on Mars The radiometric observations indicate that during the summer season on Mars, temperature conditions at noonday are not unlike the bright cool days on this earth, with temperatures ranging from 5° to 15° C or 40° to 60° F

Sir William Thiselton-Dyer and the "Flora Capensis"

THE publication in the *Kew Bulletin* (No 7, 1925, pp 289-293) of an account, by Sir W T Thiselton-Dyer, of the commencement, progress, and completion of the "Flora Capensis," affords a fitting opportunity of recalling Sir William Thiselton-Dyer's work at the Royal Botanic Gardens, Kew, and more especially the work he has done for the British Empire in advancing the knowledge of its botanical riches in the domain both of economic and systematic botany With regard to the systematic study of the Colonial floras, the two works which are especially associated with his many years of office at Kew are the "Flora Capensis" and the "Flora of Tropical Africa" Proposals for both these works were made by Sir William Hooker, so long ago as 1863, when *inter alia* he put forward a proposal for a flora of the "South African Colonies" in ten volumes and a flora of the "West African Colonies" in two volumes Out of the former proposal has come the now completed "Flora Capensis" and from the latter the "Flora of Tropical Africa," which, when finished, will occupy eleven or twelve volumes

The "Flora Capensis," as Sir William Thiselton-Dyer states, had, however, actually been commenced at the suggestion of Sir William Hooker It was undertaken by Dr Harvey, "sometime Treasurer of Cape Colony," the professor of botany in the University of Dublin He "undertook to print and publish the Flora at his own risk and cost, trusting chiefly to colonial subscriptions for a repayment of the outlay" Dr Sonder, of Hamburg, "gladly accepted Dr Harvey's offer to share the authorship" Volume 1, dedicated to Sir George Grey, K C B, "Governor and Commander-in-Chief of the Colony of the Cape of Good Hope," bears the publication date 1859–60 Volume 2 was published in 1862, and Volume 3 in 1865 The following year Prof Harvey died, and Dr Sonder, who took no further part in the work, died in 1881

Sir Henry Barkly, Governor of the Cape of Good Hope from 1870–77, himself an ardent naturalist and fellow of the Royal Society, urged upon Sir Joseph Hooker, who had succeeded his father as director of Kew, the completion of the work of Harvey and Sonder, and Sir Joseph Hooker suggested to Mr Dyer, as he then was, that he should undertake the completion of the work of the Cape Flora As, however, he was at that time assisting Sir Joseph in sub-editing the "Flora of British India," he was unable to entertain the proposal, and later, being appointed to the post of assistant director of Kew in 1875, he was again precluded from taking up any particular part of the Flora himself Sir William, however, was able to enlist the aid of numerous contributors in carrying on the work, but the general task of supervising and editing a work which was part of a project initiated by Kew, appeared to him to fall naturally within the scope of his official duty, and so after a long interval the "Flora Capensis" was again started

Sir William points out as a striking fact, that in the volumes published by Harvey a very large number of the species are only represented by a single collection It was highly desirable to have more copious material to work upon, if only to supply more ample data for geographical distribution, and thanks to Sir William Thiselton-Dyer a numerous body of contributors was marshalled, and they rendered valuable service in sending home material for the adequate working out of the Flora Among these Peter MacOwan and Dr Harry Bolus deserve particular mention

Sir William, in his article, refers to the fact that upwards of ten thousand specimens have been named and catalogued for South African botanists and collectors in connexion with the work of the Flora, and that during twenty years, from 1877, the time of one member of the Kew staff, Mr N E Brown, was almost exclusively occupied with the determination of these fresh accessions of South African plants Sir William bears eloquent testimony to Mr Brown's work, pointing out that from his complete mastery of the features of the flora and of South African topography "he has been the invaluable mainstay of my own share in the undertaking"

It was in 1877 that Sir William was able to start the work on the Flora on an effective basis and he was fortunate in being able to secure the co-operation of South African contributors, including Dr Harry Bolus, who undertook the Ericaceæ, Dr E P Phillips, who worked out the Proteaceæ, and Miss E L Stephens, who worked out the Penæaceæ The Orchids, which should have been worked out by Dr Harry Bolus, could not be carried out by him and were undertaken by the late Mr R A Rolfe of the Kew Herbarium staff Other contributors of whom Sir William makes special mention were Mr J G Baker, who elaborated

the "Cape Bulbs," and Mr. C. H. Wright, assistant in the Herbarium, Royal Botanic Gardens, Kew, who sub-edited the whole of the contributors' manuscript.

It is interesting to note that Sir William Hooker estimated both the number of volumes and the financial support that would be needed to carry out the work with remarkable accuracy. He fixed the number of volumes at ten, which is the number now published, and he also estimated that ten thousand would be the number of species to be dealt with. The actual number, however, is 11,705, and of these 2016 are described for the first time.

The "Flora of Tropical Africa," like the "Flora Capensis," though it owes so much to the energy and sagacity of Sir William Thiselton-Dyer, was commenced before he was able to assume any control over its preparation. Originally it was intended to be the joint work of Sir William Hooker and Prof. Daniel Oliver, Keeper of the Kew Herbarium; but the work was handed over to Prof. Oliver, and the first three volumes appeared in 1886, 1871, and 1877 respectively. Then, as with the "Flora Capensis," came a long break, and it was not until Sir William Thiselton-Dyer was able to take the matter in hand that the preparation of this flora could be resumed. As an outcome of his activities a new volume of the Flora appeared in 1898 devoted to the petaloid monocotyledons, Volume 7 of the entire work, this being the first volume to be produced under Sir William's editorship. This was followed in due course by Volume 4, published in two sections, Volume 5, Volume 8 and Volume 6, Section 1, the latter, which was published in 1913, being the last to appear under his editorship. The Flora has been continued under the editorship of Sir David Prain, and only some two parts, dealing with the grasses, now remain to be published.

The work entailed in arranging for the collection and naming of the material for these two great works would, it might well be thought, be sufficient to have occupied the full attention of the director of Kew, upon whose time there are so many calls with regard to botanical problems both at home and abroad; nevertheless, Sir William found time to initiate yet another work, *The Kew Bulletin of Miscellaneous Information*, for the purpose, more especially, of disseminating knowledge about the economic botanical products of the Empire. The *Bulletin* was started in 1887 and is still in a flourishing condition, despite one or two times of difficulty—one of which was during the War, when an attempt was made to suppress it on the mistaken idea of economy.

Sir William's preface, which we quote, fully explains the scope and purpose of the work:

"It is proposed to issue from time to time, as an occasional publication, notes too detailed for the Annual Report on economic products and plants, to which the attention of the Staff of the Royal Gardens has been drawn in the course of ordinary correspondence, or which have been made the subject of particular study at Kew. It is hoped that while these notes will serve the purpose of an expeditious mode of communication to the numerous correspondents of Kew in distant parts of the Empire, they may also be of service to members of the general public interested in planting or agricultural business in India and the Colonies.

"W. T. THISELTON-DYER,
"Director.

"1st January 1887."

The present condition of the Kew Museums is also largely due to Sir William Thiselton-Dyer. Originally started by Sir William Hooker, the collections grew apace and fortunately they came under Dyer's purging hand, with the result that much encumbering dross was removed and the economic products were displayed to the best possible advantage. At the same time the Museum guides were produced and put on sale, in order that the public might be provided with accurate information on the wealth of the vegetable kingdom and the economic products derived therefrom.

These, with the two African floras and the *Kew Bulletin*, are a record of service which is of the highest importance, not only in the development of our knowledge of the botanical resources of the Empire but also because of the impetus this gives to scientific research in botany.

Such services as these, and many other activities displayed by Sir William Thiselton-Dyer in various botanical enterprises, have rarely been surpassed in value and importance by the labours of any other public servants to whom the British Empire owes so much.

Obituary

PROF. FELIX KLEIN, FOR. MEM. R.S.

FELIX KLEIN, who was born at Dusseldorf on April 25, 1849, died on June 22, 1925. He had been professor at Gottingen since Easter 1886, having previously been at Erlangen (1872–1875), Munich (1875–1880), and Leipzig (1880–1886). With a trenchant expository style, revealing a forceful genial character, he wrote on almost every branch of mathematics; he was editor of the *Mathem. Annal.* from the time of the death of Clebsch (1872), originator of the "Enzyklopadie" for mathematics and mathematical physics (from 1895), and, in his own country, worked incessantly for a living co-operation of physics, engineering, and mathematics, and (since 1908) to bring the teaching in the schools into touch with current scientific problems. He was also a constant traveller and lecturer; was twice in America and many times in England, since 1873. His exceptional personality appeared at once after his student days at Bonn; he took his doctor's degree at the age of nineteen; issued the second part of Plucker's book on line-geometry at the age of twenty; by the end of 1871, when he was twenty-two, had published eighteen original papers (some of these with Lie); by the end of 1875 he had published forty. Many of these are still mines of suggestiveness; his Erlanger Programm (1872) has been translated into English, French, Italian, Polish, Russian, and Hungarian.

Klein's mathematical papers were published, under his own supervision, in three volumes, in 1921–1923, containing more than two thousand beautifully printed pages; in these is inserted a running personal commentary; in effect, a detailed account of his scientific

thoughts and aims from the age of eighteen, with many references to colleagues and pupils. These volumes, intensely interesting from so many points of view, are the sufficient and authentic basis for a review of his life.

It appears, what will be new to many, that Klein's life was lived under a resolve, never relinquished, made when serving Plücker as assistant for his lecture on experimental physics, to devote himself to physics. He desired only, first, as a preparation for this, to make himself acquainted with all branches of mathematics, in order to trace the connexions of their leading ideas, and to be in a position to raise physics to a higher plane. The notes enable us to trace how this resolve was modified by circumstances, and only realised in the work of others whom he inspired: two leading causes are brought out—his pre-eminently sympathetic temperament, and a serious breakdown of health at the age of thirty-three. It seems clear that he worked mainly by discussion with friends and pupils, and by lecturing. His vivid account of the time spent with Lie in Paris in the early part of 1870; his evident interest in meeting Sylvester, Cayley, Clifford, and Ball at the British Association at Bradford, in 1873; and the reference to the happiest time of his productive activity (1876–1880), when he, from Munich, and Gordan, from Erlangen, each travelled a long way to enjoy on Sundays a *Mathesis quercupolitana* at the half-way Eichstadt, are examples of what appears throughout.

Now such discussions were conditioned by the interests of his colleagues, as his early work had been influenced by his teachers (Plücker, Clebsch, Weierstrass, Kummer); and thus Klein was led into giving his publications a form quite other than physical. We see, however, how he fought to maintain his early resolve, particularly in the manner of approach to Riemann's theory of functions, and, later, in his volume (with Sommerfeld) on the motion of the top. This begins in a mathematical way; but, in the course of the thirteen years occupied in its publication, reaches a very technical plane. But besides this concession to his surroundings, it appears that, first at Munich, and then more seriously at Leipzig (in 1882), he was warned that he could not continue to work with the same intensity, and must needs live on a different level. Thus he began to limit himself to the supervision of the long series of books and lectures, on almost every subject of mathematics and mathematical physics, of which the detailed work was carried out by others.

Meanwhile Klein's unceasing anxiety for the organic working union of physics and mathematics expressed itself in administrative ways. He secured, one can imagine with what trouble, a co-operation of German Academies, to bear the responsibility for the "Enzyklopädie"; he travelled hither and thither to secure competent contributors, especially to England (there being, as he explains, no sufficient sympathy in Germany between mathematicians and physicists); himself undertook the part dealing with mechanics, in connexion with which he obtained the translation into German of Routh's "Dynamics," Lamb's "Hydrodynamics," and Love's "Elasticity." In his own Göttingen, later on, were founded a Physical Institute, with the help of German manufacturers, and a society for the encouragement of mathematical physics; to him it appeared "Mechanik, überhaupt angewandte Mathematik, kann nur durch *intensive Beschäftigung mit den Dingen selbst gelernt werden*; die Literatur gibt nur eine Beihilfe." He took every opportunity, by visits to conferences and lectures, to keep in touch with engineers and physicists; he organised vacation courses for teachers to give their teaching the proper modern orientation; and finally, from 1908, he gave his attention to the schools, and lamented the ruin the War had wrought in the extensive preparations made for an international campaign.

Little need be said in this place of the brilliance of the mathematical papers, especially of Klein's earlier years. If the reader agrees with Poincaré, in a letter quoted here, "Je ne crois pas qu'une démonstration puisse être résumée; on ne peut en retrancher sans lui enlever sa rigueur et une démonstration sans rigueur n'est pas une démonstration," he will find here, also, Klein's reasoned reply. Nor need we think that his international aims were not genuine because of his evident patriotism, and his desire to see Göttingen "über Alles." These are desires which he would have commended in others. For we are bound to feel that his life was devoted to a very real and practical problem of our time, and that he worked at it loyally and unremittingly—namely, how to bring under as few points of view as can be grasped by one man the astonishing output of physical and mathematical thought in the last hundred years. The difficulty is not that the ideas involved are so wide apart; on the contrary, they are very cognate—Bohr uses the ideas of the theory of Abelian functions, and would use the approximation theory elaborated by Lagrange, combined with Planck's physical results, to construct an explanation of spectrum lines; Einstein uses an absolute differential calculus, tracing its origin to Lie's work for continuous groups as well as to Riemann's thoughts on geometry, with a realistic outlook such as was discussed by Mach, to found a new calculus for the motion of material bodies. It is probably the case that the grooves in which the mind of the physicist can move to elaborate his theories, have generally been worn by the imagination and systematising efforts of the mathematician, who, in rare cases, may be the same person; and it is certain that only by the development of all aspects of thought can progress be continued. But how shall one man secure an adequate understanding of all that may concern him in the work of so many others? Must we say that the answer is that only if the civilised world can continue in patience and amity to co-operate to this end, can the end be reached?

At least we owe honour to the commanding personality and penetrating intellect of Felix Klein, for his life's devotion to the solution of the problem.

COUNT GOBLET D'ALVIELLA

THE death of Count Goblet d'Alviella on September 8 as the result of a motor car accident is announced from Brussels. Count Goblet d'Alviella was born in 1846, and for some time was professor of the history of religion at the University of Brussels. He had a distinguished career in public life successively as a member of the Chamber of Deputies, member of the Senate, of which he became vice-president in 1912, and Minister of State and member of the cabinet during the War

He held the degree of doctor of philosophy, and the Universities of Edinburgh and Glasgow had conferred upon him honorary degrees In 1891 he delivered the Hibbert Lecture, his discourse being published afterwards under the title, "A Lecture on the Origin and Growth of the Conception of God as illustrated by Anthropology and History" He was the author of a number of books, including "Sahara and Lapland Travels in the African Desert and the Polar World," which was published in an English translation in 1874, and "The Contemporary Evolution of Religious Thought in England, America, and India," published in England in translation in 1885

Goblet d'Alviella's most important work, however, was "La Migration des symboles," published in Paris in 1892, and in an English version with a preface by Sir George Birdwood in 1894 This book embodied material originally appearing in the *Bulletin de l'Academie Royale de Belgique* and elsewhere, but in much extended form The study of forms of symbolism had at that time fallen somewhat into disrepute owing to the unscientific and highly speculative methods of earlier writers such as Depuis and Creuzer, but Goblet d'Alviella placed it on a secure footing by the application of inductive methods and comparative study As Sir George Birdwood said in his foreword, he "raised the inquiry to its proper position as a department of archæological research, producing a work destined to exert an abiding influence on the whole future of the study of symbolism"—a prediction which time has not belied This book still remains the best study of the principal symbols employed in early decorative art, such as the swastika, the triskele, the tree of knowledge, and the winged disc It is interesting to note that while Goblet d'Alviella derived each of such symbols in the main from a single origin in some one centre, he was prepared to admit that in certain areas and in favouring circumstances they probably had arisen independently

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We regret to announce the following deaths

Prof C Chandler, formerly professor of chemistry at Columbia University, New York a former president of the American Chemical Society and an original and an honorary member of the Society of Chemical Industry aged eighty-eight years

Prof Albert T Clay professor of Assyriology and Babylonian literature in the Graduate School of Yale University and president of the American Society for Oriental Research on September 14

Sir Francis Darwin, formerly reader in botany in the University of Cambridge, on September 19 at seventy seven years of age

Dr William C Farabee, curator of the American section of the University of Pennsylvania Museum distinguished for his archæological and ethnological work in South America on June 24 aged sixty years

Prof W S Hendrixson, professor of chemistry since 1890 at Grinnel College Iowa, known for his contributions to the study of electrometric methods in chemistry, on July 1, aged sixty-six years

Senator E F Ladd formerly professor of chemistry at North Dakota College and president of the Agricultural Experiment Station on June 22, aged sixty-five years

Dr Georg von Mayr professor of political economy and statistics in the University of Munich and an honorary member of the Royal Statistical Society, aged eighty-four years

M Auguste Pavie an honorary corresponding member of the Royal Geographical Society, who carried out important explorations in Indo-China, Siam and Upper Annam, adding considerably to our knowledge of French possessions in Asia aged seventy-eight years

Prof F Ranwez professor of pharmaceutical chemistry in the University of Louvain and president of the International Congress of Pharmacy held at Brussels in 1897 aged fifty-nine years

Dr Georg A Schweinfurth, distinguished by his geographical, botanical, and ethnographical work in Africa, on September 19, at eighty eight years of age

Dr A Tuckerman known especially for his bibliographic work in the United States on the literature of the spectroscope and of thermodynamics, on May 25, aged seventy-seven years

Prof Charles Velain, the first occupant of the chair of physical geography in the Faculty of Sciences of the University of Paris and founder of the "Revue annuelle de Géographie,' on June 6, aged eighty years

Prof J B Woodworth, of the Department of Geology and Geography at Harvard University since 1890, a pioneer in the scientific study of earthquakes who was also known for his work in the glacial geology of Brazil and other areas, on August 4, aged sixty years

Current Topics and Events

At the recent meeting at Southampton of the British Association, it was a subject of general remark that modern scientific thought shows a striking drift away from the facile generalisations of the Victorian age The progress of research in the sciences bearing on agriculture illustrate this change to a very marked degree, and the report of the Rothamsted Experimental Station for the years 1923–1924, which has just been issued, bears witness to the number and variety of the investigations in progress at the premier institution for agricultural research in Great Britain The list of scientific papers published from the Station during the period reached the remarkable total of fifty-eight The Physics Department alone was responsible for thirteen papers, of which three appeared in the Proceedings of the Royal Society Under the various sections of this report dealing with the many physical and biological factors which enter into plant growth, we are constantly met with references to the interplay of contending forces In the soil, in place of absolute values assigned to specific plant nutrients (*teste* Page) colloidal calcium- and other complexes now figure as the battle-ground of warring ions, and in the biological field, as the work of Cutler and Thornton has shown, much depends on the ebb and flow in the bacteria-protozoa conflict Superimposed on all these come the vagaries of the weather, an extraordinarily difficult factor to measure The work of evaluating all these factors falls to the Statistical Department, the activities of which (perilously esoteric !) are ably directed by Mr Fisher

THE outlook of Rothamsted is, in the main (and rightly) academic, but if there is any department the concern of which more intimately touches upon existing economic conditions, it is that dealing with the physics of the soil, in charge of the Assistant-Director Dr Keen Costs of "cultivations"—man and horse labour—may approach three-fourths of the total cost of home-grown crops, and at the present rates of wages the homeland is almost hopelessly handicapped—a topic, by the way, prominently brought to notice at the Southampton meeting by Sir Daniel Hall and Sir Henry Rew It may be hoped that the new Research Institute in Engineering recently founded at Oxford will find it possible to enter into intimate co-operation with the fundamental work on cultivations now going on at Rothamsted We notice a reference in the report to a matter of considerable public interest and that is, the problem of exploiting, on a commercial scale, discoveries made in laboratories supported by large grants from the State The Rothamsted authorities are happy in finding, in Lord Elveden, a patron who is willing to undertake the commercial development of the discovery made by Hutchinson some years ago of a method of making "artificial' farm-yard manure The report also contains the details of the various field experiments which are in progress at Rothamsted, as well as full particulars of the interesting investigations conducted by Dr Voelcker at the farm at Woburn, the maintenance of which the Royal Agricultural Society somewhat precipitately jettisoned some years ago

AT the second Pan-Pacific Science Congress held in Australia in the summer of 1923 the invitation of the Japanese delegation to hold the third congress in Japan in 1926, under the auspices of the Japanese National Research, was accepted, and a preliminary announcement has recently been issued The main objects of the Congress, like those of 1920 and 1923, will be the promotion both of co-operation in the study of scientific problems affecting the Pacific region and of the sense of brotherhood among the scientific workers of the countries concerned as a means of strengthening the bonds of peace among the Pacific nations To these ends, the programme will consist largely of symposia upon selected subjects Three discussions suggested provisionally for general sessions of the whole Congress deal with the physical and biological oceanography of the Pacific, radio-transmission in the Pacific region, and the geotectonics of the Pacific area respectively The provisional programme for the Division of Physical Sciences includes discussions, with special reference to the Pacific region on solar activity, terrestrial magnetism, meteorology the strand-line during Pleistocene and post-Pleistocene time, the correlation of Mesozoic formations, metallogenic epochs, volcanoes and earthquake proof constructions The Division of Biological Sciences will probably discuss the floras and faunas of the various countries and islands of the Pacific and their relationships, plant successions and quarantines, the protection of aquatic animals, the genetics of live-stock and crops particularly rice the antiquity of man and the diseases of native races Other suggested discussions deal with astronomical observations, earthquake observations, geodesy, oil-bearing formations, thermal springs, storage of cereals, green manuring diseases of animals, anthropometry, tropical diseases and food, drugs, clothing, and housing in the Pacific region It is stated that the committee authorised at the Congress in 1923 to effect a permanent organisation of scientific institutions of the countries of the Pacific has been set up It contains representatives of the countries of the region and of the European powers interested in the Pacific

THE International Commission of Eugenics is a body originally nominated by the International Eugenic Congress with power to co-opt additional members The International Congress of Eugenics meets every five years, and the Commission was intended to afford eugenists opportunities for the exchange of views and mutual consultation at more frequent intervals The fourth meeting of the Commission was held in London in July the third meeting having taken place last year at Milan The London meeting was attended by representatives from the United States, France, Holland, Belgium, Italy, Denmark, and Norway Two important resolutions were agreed to, the first moved by Dr Davenport, the American representative to the effect that, as every nation has a right to determine who shall be included in its body politic, so it is expedient that every immigrant-receiving country should inquire into the family and personal history of each would-be immigrant, and the second, also moved by Dr Davenport, that the standard pedigree chart devised by Miss Van Herwerden should be printed and published by the Commission as the best and most practicable form of recording such histories Dr Collin one of the Norwegian representatives agreed to summarise the most recent theories as to the causes of the rise and fall of civilisations, and report on the subject to the next meeting of the Commission Dr Mjoen, the other Norwegian representative, delivered an interesting lecture on the inheritance of musical ability He showed clearly that it was impossible to explain this inheritance as the results of the passing on and segregation of a Mendelian factor He adopted the device of postulating the existence of numerous factors inherited separately these factors were, however arbitrarily chosen and ill-defined

IN a report circulated by Science Service of Washington, D C which appears in *Science* for August 2 it is stated that a joint expedition of the Smithsonian Institution and Amherst College has discovered a crushed human skull associated with stone arrow-heads and the remains of mammoth and mastodon near the towns of Melbourne and Vero, Florida Above the elephant stratum pottery was found among an accumulation of recent shells, and in the sands below, teeth of horse camel, and sabre-toothed tiger, indicating a characteristic Pleistocene fauna Dr J W Gidley, leader of the expedition, is confident that the human remains were not buried in the

mammoth strata. The inference drawn is that the mammoth and mastodon survived in this area of Florida for some 10 000 years after those of which the remains have been recently discovered in Indiana and are assigned to the late Pleistocene. The result of further investigation of the evidence will be awaited with interest, and should it confirm the conclusion here stated, the late survival of the mastodon may serve as a possible explanation of the association of human remains with bones of the mastodon at Natchez, which those who deny high antiquity to man in America have hitherto been constrained to explain as due to burial or fortuitous causes and as affording no evidence for contemporaneity.

As agreed at the conclusion of the World Power Conference held at the British Empire Exhibition, Wembley, last year, the International Executive Committee met in July last for the purpose of discussing the future activities of the movement. An invitation to hold the second World Power Conference at Basel in 1926, on the occasion of the Internal Exhibition for Inland Navigation and Utilisation of Hydraulic Power, was refused on the ground that a longer period than one or two years was desirable between plenary sessions of the Conference. Meanwhile, however, it was decided to hold sectional meetings in various areas, under the auspices of the International Committee, to discuss programmes on specific subjects within the general conference programme. An invitation was accordingly sent to the Swiss National Committee to hold a sectional meeting at Basel in 1926 for the discussion of the development of hydro-electric power combined with inland navigation, the interchange of electric power between countries, the economic relation between hydro- and thermal power, railway electrification and electricity in agriculture, stress being laid particularly on financial and economic aspects. The International Executive Committee further recommended, as a means of securing the continuity of the Conference movement, that a *Journal of the World Power Conference* should be published at regular intervals. It was decided, subject to reconsideration at a later meeting, that the second World Power Conference should be held at Rome in 1930.

IN the *Lancet* of September 12 there is an important paper on the experimental treatment of implanted malignant tumours of the rat, by Dr. Thomas Lumsden, of the Lister Institute. A short time ago, Dr. Lumsden published the results of the action of an anti-serum which had been prepared by injecting rats or rabbits with emulsions of ground-up cancerous tumours of mice. When such a serum was brought into contact with cultures of cancer cells, the latter were injured or destroyed. Normal serum had no such effect, and the cancer serum had no effect on cultures of cells other than cancerous. Thus a fragment of heart culture could flourish and beat in anti-cancerous serum. Dr. Lumsden, in his new paper, has extended these results to the possible therapeutic action of such anti-sera. When rats were inoculated on the foot with a fragment of Jensen rat sarcoma—a highly malignant tumour—the resulting new growth could be made to disappear when the anti-serum was injected locally and prevented from diffusing itself through the body too quickly. Remarkable to say, the animal after the cure of its tumour by serum was found to be immune and could not be reinfected. When rats were inoculated on two of their feet, the resulting tumours both disappeared when the serum was injected locally into only one of the tumours. Further developments of this work will be awaited with interest.

THE probable rainfall in India during August and September, based on the weather in India in June and July, associated with the weather conditions in other parts of the world which are most likely to influence the coming rains in India, was issued on August 7 to the Government of India by the Director-General of Observatories. In both June and July the monsoon was normal in activity; the rainfall for the two months over the plains as a whole was about 5 per cent. in excess of the normal. There was an excess of more than 50 per cent. in Orissa, the United Provinces west, and the Punjab east and north, of 20 to 50 per cent. in the United Provinces east, Baluchistan, Rajputana east, Central India east and the Central Provinces east, and a defect of 20 to 50 per cent. in Kashmir, Sind, Berar, Hyderabad north and Mysore. In the remaining subdivisions the total rainfall of the period was within 20 per cent. of the normal. It is summarised that there is no strong reason to expect any large excess or defect in the total rainfall of August and September either in north-west India or in the Peninsula. The Bombay correspondent of the *Times* reports, however, under date September 19, that the monsoon, which until a fortnight ago was favourable everywhere, shows signs of failing, and that rain is badly needed in many districts in the south of India.

AN adequate supply of pure distilled water is an indispensable requisite in all chemical and in most physical laboratories. If the consumption be very small and the degree of purity required be only "reasonable," the commodity can usually be purchased with impunity from the local druggist; but in all other cases it must be prepared in the laboratory. Common defects of the ordinary still are painfully slow rate of production, and "accidents" with the gas or water-supply. The patent automatic tin-lined stills supplied by Messrs. Brown and Son (Alembic Works), Ltd., of 9 Wedmore Street, London, N. 19, as has been found from many years' experience, are free from these faults. The rate of distillation secured with this still is many times greater than that obtainable with any of the old-fashioned types, and the mechanical device ensuring that the water-supply is turned on simultaneously with the gas-supply, makes the apparatus as fool-proof as possible; it does not, however, prevent minor mishaps due to fluctuating pressure in the gas and water mains. Such fluctuations are a source of great annoyance in many chemical and physical operations, and simple, cheap devices for counteracting them are badly needed. The new catalogue issued by Messrs.

Brown and Son contains illustrations and particulars of stills heated by gas, steam or oil, together with information concerning their output per hour.

IN Bulletins 746 and 747, the United States Geological Survey has published a Bibliography and Index to the "Geologic Literature on North America, 1785–1918," compiled by John M. Nickles. These two volumes will be extraordinarily useful to geologists all over the world. The flood of geological literature is so great that it is always difficult to keep pace with it and an important work of reference such as this is what the late Prof. Cole would have called a very real aid to practical geology. It should be noticed that the publications indexed refer to the whole of North America from the West Indies to the Arctic and to the Hawaiian Islands. In Part I. the names of authors are arranged in alphabetical order, papers being listed in chronological order in each case. About 45,000 titles are indexed in this way. Part II. is a subject index and contains about 70,000 headings.

THE officers of the Röntgen Society for the session 1925–26 are as follows:—*President*, Dr. F. W. Aston; *Vice-Presidents*, Dr. Robert Knox, Mr. N. S. Finzi, Prof. A. W. Porter; *Hon. Treasurer*, Mr. Geoffrey Pearce; *Hon. Editor*, Dr. G. W. C. Kaye; *Hon. Secretaries*, Dr. E. A. Owen, Mr. Russell J. Reynolds.

DR. WILLIAM C. REYNOLDS, referring to his letter in NATURE of September 12, p. 394, states that data regarding the troposphere and stratosphere provided in Dr. G. C. Simpson's presidential address to Section A (Mathematics and Physics) suggest that the optical, electrical, and thermal zones probably coincide—a simple and important geophysical condition. An aeroplane observer at sunrise and sunset should, therefore, have three separate methods of determining the limits of the lower zone. Such data regarding the thermal zones as Dr. Reynolds had when writing his earlier letter appeared to place the stratosphere higher up.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant lecturer and demonstrator in engineering and an assistant lecturer and demonstrator in mining and mine-surveying at the University College of South Wales and Monmouthshire, Cardiff—The Registrar (October 3). A senior lecturer in pure mathematics in the University of Cape Town—The Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, London, W.C.2 (October 20). Junior technical assistants in the wireless experimental department of the Royal Aircraft Establishment—The Superintendent, R.A.E., South Farnborough, Hants (quoting A. 79).

Our Astronomical Column.

BROOKS' PERIODIC COMET.—A telegram from the International Astronomical Union Bureau, Copenhagen, announces the detection of this comet by Prof. Tcherny at Kief Observatory; its position on Sept. 19 at $19^h\ 9.5^m$ Universal Time being R.A. $23^h\ 17^m\ 36.9^s$, S. Decl. $5°\ 12'\ 11''$. The magnitude was 9.5, considerably brighter than the predicted value, which was about 12; there is therefore a possibility that the comet is not identical with that of Brooks. The R.A. is $18^m\ 49^s$ in excess of Prof. Dubiago's prediction, the Decl. $15.3'$ south of it. The predicted elements were:

$$\begin{aligned} T &= 1925 \text{ Nov. } 8.5838 \text{ U.T.} \\ \omega &= 195°\ 48'\ 59.4'' \\ \Omega &= 177\ \ 25\ \ 36.5 \\ i &= \ \ 5\ \ 42\ \ 44.6 \\ \phi &= 29\ \ \ 0\ \ 41.0 \\ n &= 510.9845'' \end{aligned} \quad \left.\begin{matrix}\\ \\ \\ \end{matrix}\right\} 1925.0$$

The correction to T from the R.A. is -5.354 days, that from the Decl. $+0.942$ days. These are considerably discordant, and strengthen the suspicion of non-identity. If it is Brooks', the appropriate weights are 3 to R.A., 1 to Decl.: weighted mean -3.78 days.

The perturbations at the last aphelion passage were very large, the distance from Jupiter being less than 8 million miles. Curiously, Wolf's Comet made a similar approach at about the same time.

The following ephemeris for 0^h is found from that of Dubiago by applying $+18^m\ 49^s$ and $-15.3'$:

	R.A.	S. Decl.
Sept. 26	$23^h\ 15^m\ 47^s$	$6°\ 1'$
" 30	23 14 58	6 31
Oct. 4	23 14 34	6 57
" 8	23 14 33	7 20
" 12	23 15 0	7 40
" 16	23 15 56	7 56

On Sept. 26 the comet is due south about 23^h. Its distance from the earth is 0.9 unit.

MARS.—Prof. W. H. Pickering observed Mars last year from Mandeville, Jamaica, and gives in *Popular Astronomy* for August-September an interesting summary of his own and other observations. He reproduces some early photographs of Mars taken on ordinary plates in 1888 and 1890. Some of these show the prominent markings obliterated by a whitish veil, like Mr. Wright's recent photographs on ordinary plates; this corresponds (as both observers noted) to the fact that terrestrial photographs on ordinary plates fail to show distant objects plainly visible to the eye, while red-sensitive plates show them. Others of the old photographs show the dark markings plainly, indicating that the clearness of the Martian atmosphere is subject to large variations. Prof. Pickering agrees with Mr. Wright in concluding that the atmosphere is denser and more extensive than was recently thought probable. He argues in the same direction from the recent thermopile measurements, which indicated a temperature well above the freezing point. As the desert regions showed a lower temperature than the maria, he conjectures that they are more elevated. Assuming a temperature gradient similar to that on earth, he gives the mean elevation as 8000 feet.

There are detailed descriptions of some of the large clouds that appeared in the equatorial regions at the last apparition. One of these was 1200 miles by 500 miles, its rate of motion being 24 miles per hour.

In common with several other observers, Prof. Pickering looks on the presence of vegetation on Mars as practically assured, and presumes that this implies the presence of at least some forms of animal life. There has been a pendulum-like swing in views on Mars; in the middle of the last century it was generally looked on as a miniature of the earth. Towards the end of the century the view of its non-habitability was widely held; now we notice a tendency to revert to the earlier view.

Research Items

A CHIBCHA TEMPLE IN COLOMBIA —In 1924 an official Commission identified and investigated the site of the Chibcha Temple of Suamox which was burnt in 1537 by the troops of Quesada, who had been attracted thither by reports of its riches The Commission consisted of Gerardo Arrubla and General Carlos Cuerva Marques the former of whom describes the results of these investigations in the English edition of *Inter-America* for August By a careful examination of the chronicles and traditions and of trustworthy witnesses and by exploration on the ground, the Commissioners were able to fix the site of this Temple of the Sun with certainty in the city of Sagamoso itself Excavation confirmed the traditional account that it had been built of wood and had been destroyed by fire Tradition also has it that the wood used had been carried from a great distance on the backs of the Indians It was found that the wood of the temple columns does not grow in the valley or nearer than the plains Each pillar was said to have been erected on the body of a sacrificed slave, and human remains with small objects of gold, stone, clay, and shell were actually discovered at the base The temple was circular in form and had a diameter of 36 metres a remarkable size considering the rudimentary architecture of the Chibcha

THE ORIGIN AND DISTRIBUTION OF TREPANNING —Dr Wolfel of Vienna has made an exhaustive study of the practice of trepanning among primitive peoples of which Part I appears in Hefte 1-2 Bd xx, of *Anthropos* The operation was practised in prehistoric Europe and in North Africa it persisted in Albania and Serbia and among the Berbers It occurs in Melanesia and New Guinea, and a number of skulls have been found in America which show that it was employed by the inhabitants of the Mississippi Basin in Mexico and in the Andean region In the present section of his work, Dr Wolfel deals with Melanesia and New Guinea and America, and, after a comparative study, concludes that in these two areas it is an element in a common culture complex In Melanesia and New Guinea its use is mainly surgical especially for healing wounds caused by stone clubs or sling stones by removing fractured bone It is also practised for epilepsy and headache as a matter of fashion and to secure longevity It has also a magical implication Essentially however it is to be connected with the use of the stone club and sling in war Turning to America the skulls which have been found occurring even so far north as Lake Huron, show that trepanning was adopted as a method of dealing with a crushing blow such as might be caused by a stone club or sling Here also there is evidence of disease and MacCurdy directs attention to traces of cauterisation Although the existence of the sling in pre-Columbian America has been denied, there is sufficient evidence to call for the revision of this conclusion, *e g* in the Winland slingers of the Saga of Eric the Red, the Algonkin devil-head slings among the Beothuk of Newfoundland, and so on The existence and distribution of stone-headed clubs is also well attested It is therefore to be concluded that trepanning is an element in a culture complex which was associated with the stone-headed club and coheres with the 'two-class' system common to both the South Seas and America

TEMPERATURES IN EUROPE DURING THE TERTIARY PERIOD —A paper with the title 'Der Einfluss der variabeln Erdbahnelemente auf das morphogene Warmebild Europas im Tertiar' is published in the 1924 year book of the Academy of Sciences Vienna The author M F Kerner-Marilaun read the paper before the mathematical-physics class and he deals with the influence of variable elements in the earth s orbit on the temperature distribution in Europe in tertiary times Von Spitaler s calculations of temperature in pure land and sea climates were used to establish regions with extreme temperatures in tertiary Europe For winter temperatures, values calculated earlier by the author were employed while special formulæ were developed to obtain the summer temperatures and from these results the temperatures for the places of thermal extremes were found By the variations of flora in horizontal and vertical directions the regional and zonal fluctuations of temperature caused by astronomical variations can be traced It is not always possible to trace the influence of each heat wave in an oceanic climate, because other influences may mask the changes to be examined

THE ORIGIN OF CONTINENTS —In *Die Naturwissenschaften* for July 31, Dr Otto Ampferer of Vienna discusses in detail the various possibilities arising out of the distribution of the continents He accepts Wegener s conception of the sial and sima layers, but believes that there are probably more than two layers of different density and that in particular a third layer intermediate between sial and sima may underlie the continents If vertical movements alone are postulated then the oceans may be due to simple sinking either by bending without fissures, or by in-breaking with bordering faults This corresponds with the requirements of the contraction theory but it is pointed out that expansion would lead to a similar result the continents being then due to relative uplift The existing evidence of both compression and tension in the earth's crust implies that both processes have contributed to some extent at least However the tectonic study of mountain ranges has proved beyond doubt that very large horizontal displacements have actually taken place, implying that extensive regions of the continents have been bodily moved Vertical movements alone cannot explain these extraordinary thrusts and Ampferer believes that in addition, horizontal movements, independent of those arising from compression, must be postulated He shows that Wegener s displacement theory involves the difficulty that it provides no possibility of explaining two absolutely opposed processes the first, the compression of the original uniform shell of the earth into a primeval continent collected around Africa and the second, the subsequent break-up and dispersal of the land area into the continents of to day Wegener suggests for the cause of the dispersal only relatively feeble external forces Ampferer insists that some entirely different kind of phenomenon is necessary He does not discuss the recent views of Joly, Holmes, or Evans, all of whom have contributed to a possible solution but he favours the idea that under-streaming currents within the earth may be responsible Ascending currents beneath the continents would raise and split them, and carry the fragments in all directions, whereas Wegener s forces would lead to a definite direction of drift

RAINFALL IN AUSTRALIA —The rain map of Australia for 1924, which is published by the Commonwealth shows the distribution of precipitation for each month, and contains also a detailed map of the annual fall indicating excess and deficiency compared

with the normal. The year was similar to 1923 in its marked rainfall contrasts. In the north-western part of the continent there were severe drought conditions, while on the other hand, in eastern Australia, including Tasmania, there was abundant rain, making the year one of the most favourable on record for pastoral and agricultural interests. Winter was comparatively dry, but in August widespread rainfall set in and continued for three or four months. In December the rains decreased, and harvesting conditions were ideal in most parts. Over the continent as a whole, 27 per cent of the area had a rainfall above the annual average. This compares with 22 per cent in 1923, 21 per cent in 1922, and 63 per cent in 1921. In 1924, however, the excess above the normal was almost entirely confined to the eastern part of the continent.

TERRESTRIAL MAGNETISM.—Several new propositions with regard to terrestrial magnetism are announced in the June issue of *Terrestrial Magnetism and Atmospheric Electricity*. The fact that magnetic storms increase in frequency with the sun-spot numbers has been known for some time, but Dr. A. Podder, of the Irkutsk Observatory, shows from an examination of the records of that observatory for the past thirty years that storms are more frequent in March and in September than in any other months, and traces this to the passage of the earth in those months through the plane in which the centres of maximum activity of the sun are situated. He finds there is also a daily variation in the frequency of storms, which is independent in character of sun-spot number and of season. During each storm the deviation of the compass is reduced, the dip increased and the horizontal component of the magnetic field decreased. With regard to "sudden commencements," Dr. L. A. Bauer finds from an examination of the records of 30 disturbances that while there may be cases in which they occur simultaneously at all points, the speed of propagation may be so low as 1000 kilometres per second along parallels of latitude and only 100 kilometres per second from the magnetic equator towards each magnetic pole.

THE PHYSICAL NATURE OF THE CORONA.—The various theories as to the nature of the solar corona are discussed by Dr. W. Anderson in the *Zeitschrift fur Physik* for Aug. 1. Taking into account the amount of light emitted by the corona, and the amount passing through it from the photosphere, he estimates that, if more than fifty per cent of the gravitational force acting upon the material of the corona is to be balanced by the radiation pressure, the total mass within one solar radius of the sun's surface must be less than 10^{16} grams. The theory of C. Fabry, which ascribes the continuous spectrum of the corona to diffusion of solar light by gases as in Raleigh's theory of the spectrum of light from the sky, does not explain the absence of Fraunhofer lines in the coronal spectrum, and is in other ways unsatisfactory. The hypothesis that gaseous particles fluoresce under the influence of the light of the photosphere is rejected, since the spectrum appears to be truly continuous, with a few bright lines, and not to be due to the superposition of a number of banded spectra due to fluorescence of different gases. It is very improbable that the coronal light is due to bombardment with corpuscular radiation of radioactive origin. The difficulty with the electron gas theory of the corona is that it requires a positive charge on the sun equal to the negative charge of the corona, and that under these conditions the extension of the corona could only be small. This difficulty may possibly be got over by assuming that Coulomb's law of electrostatic force ceases to hold for large distances. It is possible to test the universe square law of gravitational force for large distances, but this is not possible in the case of electrostatic force, and it may perhaps fall off in such a way as to account for the structure of the corona.

SHEET GLASS PRODUCTION.—Prof. W. E. S. Turner describes the modern production of sheet glass in a paper published in the Journal of the Royal Society of Arts for July 24. For many years, until quite recently, glass used for sheet had the composition SiO_2 72-74 per cent., CaO 12-14 per cent., Na_2O 12-14 per cent., the latter being mainly derived from soda ash. In two of the automatic processes recently introduced, a softer glass has been employed containing a higher percentage of sodium oxide. The presence of magnesia retards devitrification and tends to make more uniform the rate of change of viscosity. In Lubbers' process, the glass is melted in a large tank and is removed in 560-570 lb. lots in an iron ladle. This is poured into a hot "drawing pot," really a shallow fireclay dish, and a "drawing head" is lowered in. On elevating the latter the glass is drawn up into a cylinder which may attain a length of 36 ft. and is usually 30 in. in diameter. The cylinder is then split and flattened in the usual manner. Methods are now in use in which sheet glass is drawn directly without necessitating the formation of a cylinder. Two such processes are described. The Libbey-Owens process was inspired by the inventor watching a paper-making machine; molten glass is drawn from a trough over rollers on to a "flattening table," where it is annealed. In the Fourcault process, molten glass is drawn vertically upwards through a slot. The manufacture of plate glass dates from 1665 and the process has remained practically unchanged; the modified process used by Ford for manufacturing wind-screens for motor cars is described.

EXPLOSIVE GAS MIXTURES.—Papers 8, 9 and 10 of the Safety in Mines Research Board deal with the very important matter of the ignition of firedamp (H.M. Stationery Office, Nos. 8 and 9 6*d.* each, No. 10, 4*d.*). The work embodied in the reports has been carried out by Dr. R. V. Wheeler and co-workers. Papers 8 and 9 are intimately connected. It is shown that the mixtures of methane and air most readily ignited by a sustained source of heat are those containing an excess of oxygen. Such mixtures require a source of heat at a lower temperature and, moreover, a shorter period of contact (provided, of course, the temperature is above the ignition point). With other paraffin hydrocarbons (*e.g.* ethane, propane, butane, pentane) the mixtures most readily ignited by a similar source of heat contain an excess of combustible gas. The ease of ignition of paraffin hydrocarbon-air mixtures increases as the hydrocarbon series is ascended, the lag on ignition decreases under similar circumstances. Report No. 10 deals with firedamp explosions within closed vessels and the effects of turbulence, the latter being studied in relation to the maximum pressures produced and the time taken to attain the maximum pressure. Whereas considerably enhanced pressures can be obtained from weak mixtures of methane and air when they are turbulent, the most explosive mixtures (9-10 per cent. methane) are not much affected even by extreme turbulence. The maximum pressure obtainable from any quiescent mixture of methane and air, initially at atmospheric pressure, when exploded in a closed vessel is about 105 to 110 lb. per square inch. The effect of turbulence is to increase this maximum pressure by about 4 per cent. On the other hand, with both weak and strong mixtures the effect of turbulence is greatly to increase the rapidity with which the maximum pressure is attained.

The Heating of Rooms[1]

THE Fuel Research Board has published a useful paper on the heating of rooms by Mrs Margaret Fishenden and Mr R E Willgress A room of about 4000 cub ft capacity, shaded from direct sunlight, and possessing a hearth and flue, was used Air-heating was obtained by hot-water radiators or by luminous batswing gas flames placed about 6 inches above the floor The air movement was then about ¼ to ½ ft per second After entering the test-room the two observers engaged in sedentary employment for at least an hour before the comfort feelings were noted

With no source of radiation a comfortable feeling of warmth corresponded with a temperature of air and surrounding surfaces of 65° F One of 62° F was too chilly and 68° F slightly too warm This is the range for minimal evaporation of a resting clothed man in still air Increased evaporation begins at about 73° F and 72° F was the temperature at which distinct discomfort was felt

When the walls and floor were slightly cooler than the air, the air to give comfortable warmth had to be warmer *e g* 66° F for walls, etc at 63° F and 67° F for 61° F On the other hand with walls etc, at 66° F 67° F air temperatures of 63° F, 61° F sufficed When the walls etc, were more than a degree or two colder than the air, chilliness combined with stuffiness was felt, but with the walls a few degrees in excess of air temperature, very comfortable conditions were felt With the flue blocked a feeling ensued of heaviness, airlessness, and blunted mental energy Even with the flue open, air-heating was found to be far from ideal for mental work The authors concluded that a sunless room cannot be rendered entirely pleasant by air-heating alone They found that variation of wet bulb temperatures from 51° F to 57° F for a dry bulb of 65° F had no effect on the comfort feeling

With air-heating and air-flows of 2, 4 6, and 8 ft per second over the entire position of the observer, dry bulb temperatures of 69°, 72°, 75°, and 76 5° F were needed to sustain comfort The corresponding mean wet bulb temperatures were 60°, 62° 64 5° and 66 5° As was pointed out by the inventor, the ratio between the rate of cooling of the kata-thermometer and the rate of cooling of a clothed man increases as the air velocity increases because clothing exercises an increasingly important shielding effect as the air velocity rises Draught exceeding 4 ft per second became annoying, and distracted the attention from mental work

Ideal conditions conducive to mental work were got in a room with south-west aspect by an air temperature of 64° F to 68° F with October-November sunshine and open windows, and a draught of ½ to 1½ ft per second

Radiation was studied by means of a modern gas-fire, and by an open wire electric heater placed under the chimney flue Additional draught could be produced by a gas-ring in the flue thus 2½ to 4½ changes of air per hour could be had The air temperature was brought to the desired level and the subject sat at various distances from the fire While warm enough at an air temperature of 65° F without radiation, at 60° F a mean horizontal component of 30 B Th U per sq ft per hour was required to produce warmth, at 55° F 75 units at 50° F 120 units, at 45° F 170 units Radiation figures well below or above these gave chilliness or warmth

The most comfortable conditions were with 55° F and adequate radiation above this a slight feeling of mental lassitude was produced and below it a feeling of too warm on one side too chilly on the other Below 45° F it was impracticable by a fire to avoid this feeling The alpine sun may however, give one in a reclining position 500 B Th U per sq ft per second—enough for an air temperature far below freezing point It is the equable climate of Britain which makes open fires practicable In countries where the outside temperature remains for months below freezing point, air must be heated, and a closed stove or central heating is used A low temperature radiator heated by bunsen burners below red heat and 6 ft square in size was found very pleasant This is equivalent to wall panel heating which has been found successful in the Bush building at Aldwych, London

Two cylinders of water 8 inches in diameter and one-third the height of an average man were used, one of bright polished copper the other coated with lamp black and the effect of clothing on the loss of heat from these cylinders was studied The water was kept stirred In still air, a single woollen vest reduced the heat loss to 66 per cent of the unclothed black body, with an additional white serge garment to 45 5 per cent, with further black serge coat to 38 5 per cent In a draught of 2 ft per second the reductions were to 60, 42 and 36 per cent, and in one of 6 ft per second to 48 5, 32, and 25 5 per cent respectively The three garments together cut down the absorption of radiation to 20 per cent of that which was absorbed by the unclothed black calorimeter

The last part of the paper deals with the cost of heating The hot-water radiator with coke boiler is most economical for continuous heating of a small room (1000 cu ft) or for a larger room (4000 cu ft) where people cannot gather round a fire An open fire is cheapest for the larger room when occupied by a few people who can gather near it, because air-heating is not then necessary For intermittent heating, the hot-water radiator is cheapest for a small room and open coal coke, or gas fire for a larger room 'Whatever the method adopted the cost will be closely allied with the completeness of insulation of the rooms' An air space between two thicknesses of brick and double windows are two suggestions made

Here we come up against that conflict between stagnant artificial heat and good health which is not considered by the authors, but is established both by physiological research and the experience of open-air life We should aim at the least degree of heating with which we can do sedentary brain-work or skilled hand-work in comfort, and the maximal amount of window ventilation If clothes were adjusted to individual need in offices and factories, and the feet kept warm by small local units of heat far less air-heating would be necessary, and far more window ventilation made possible and in this way, and by abolishing smoke pollution and securing more sunlight catarrhal infections would be reduced It is the open-air life and not sheltering indoors in heated rooms that keeps catarrhal diseases off and the general health up

L H

[1] Department of Scientific and Industrial Research Fuel Research Board Technical Paper No 12 The Heating of Rooms a Comparison of the Costs of different Methods on the Basis of Warmth Comfort By Dr Margaret Fishenden assisted by R E Willgress Pp iv+48+6 plates (London H M Stationery Office, 1925) 1s net

Thunderstorms and Other Features of the Weather

MR BROOKS has compiled a very valuable monograph on the thunderstorms of the world [1] A "day with thunder' is the unit employed, and records are used from 3265 stations, 2680 being in Europe Maps show the percentage of days with thunder for the whole year, and for each half-year It is assumed that thunder can only be heard up to ten or twelve miles and that on the average it will only be recorded when occurring within six miles of any station Mr Brooks shares the general opinion that thunder is not heard farther than about twelve miles but this distance may frequently be doubled at night, and sometimes tripled

The maps show six areas of maximum frequency of thunder, Madagascar Central Brazil, Panama, Southern Mexico Central Africa, and Java, in which island thunder occurs on 61 per cent of all days Areas with thunder on less than 1 per cent of all days are Greenland north Iceland, north Norway, the north coast of North America the Arctic Ocean, and the Antarctic Continent There are areas of low frequency on the west coasts of North and of South America, and on the west coasts of South and North Africa, the latter area extends across the Sahara into Arabia, the other three do not extend far inland, but all of them go a long way out into the ocean All these regions are on the east side of anticyclonic areas in positions where winds from a polar direction keep the surface temperature cool, they are also in regions of cool ocean currents, and, though Mr Brooks does not actually point it out, these may have something to do with the low thunderstorm frequency the Peru, the Benguela the California, the Canaries, and the Labrador currents are all reflected in the isobronts, even the small cool current down the Korean coast shows its effect

A very interesting map is given showing what percentage of thunder occurs in winter in western Europe the 30 per cent line extends down the Norwegian coast, embraces practically the whole of the British Isles, and crosses Brittany and the north-west coast of Spain, eastward the percentage decreases, but north-westward it increases to 75 per cent for the region of Iceland and the Faroes Another map illustrates the distribution of thunder over central Europe in July, and shows that the "chief maximum of thunderstorm frequency in Europe extends in a long narrow belt at the base of the northern slopes of the Alps"

It is estimated that over the whole globe 16 000 000 thunderstorms occur per annum, if the average duration is one hour there are 1800 storms occurring at any one time, if there are approximately 200 flashes per hour in a severe temperate, or an average tropical storm, there will be 100 flashes per second over the globe The number thus estimated by Mr Brooks is of the same order as the frequency of atmospherics, which may all, therefore, be possibly due to lightning In further sections are discussed the variation of thunder with season and with latitude over both land and sea, the diurnal variation and the effect of height on thunder frequency

Mr Brooks's work is a most important addition to the literature of the subject and is one that no meteorologist can afford to be without, it will also be of value to those who take an interest in thunder storms without being themselves meteorologists

Dr Sen [2] has collected the records on wind components that have been published in the *Geophysical Journal*, and his paper is illustrated by tables and diagrams The south-north and west-east components of the wind are discussed in relation to the annual and diurnal variation, maps show the averages of the gradient the gradient wind, and the resultant wind for each month and the growth of convection winds in summer—land and sea breezes—is investigated

The scope of Mr E V Newnham's work [3] is best explained by the opening paragraph "The object of this classification is to provide a ready means for discovering whether the conditions prevailing over the North Atlantic and Europe at any time bear any resemblance to situations that have arisen in the past at about the same time of the year and further to bring into evidence any distributions of pressure which tend to recur and may be regarded as genuine types, and to determine the seasonal variations of such types" The position of anticyclones is the basis of the classification, the region between latitudes 30° N and 80° N, and longitudes 30° E and 70° W has been divided into ten areas to each of which a letter has been assigned, the position of anticyclones is shown by the capital letters of the areas over which they occur, while the position of depressions is shown by small letters

The work must have involved an immense amount of labour, Table III gives each of the 5478 days of the period concerned with the pressure distribution found on each while Table IV gives an index of the pressure distributions with the dates on which each occurred It will prove of great assistance to those who are interested in investigating types of weather and changes in types, the summaries are in an extremely convenient form for reference

C J P C

[1] Air Ministry Meteorological Office Geophysical Memoirs No 24 The Distribution of Thunderstorms over the Globe By C E P Brooks (M O 254d) Pp 145 164+4 plates (London H M Stationery Office, 1925) 2s net

[2] Air Ministry Meteorological Office Geophysical Memoirs No 25 Surface and Geostrophic Wind Components at Deerness Holyhead, Great Yarmouth and Scilly By Dr Sachindra Nath Sen (M O 254e) Pp 165 178+6 plates (London H M Stationery Office 1925) 2s net

[3] Air Ministry Meteorological Office Geophysical Memoirs No 26 Classification of Synoptic Charts for the North Atlantic for 1896–1910 By E V Newnham (M O 254f) Pp 179 200+1 plate (London H M Stationery Office 1925) 6s net

The International Psycho-Analytical Congress

(FROM A CORRESPONDENT)

THE ninth international Psycho-Analytical Congress which assembled on September 3-5 at Bad Homburg Germany was marked by some interesting features Unlike its predecessor which met at Salzburg at Easter 1924, under the shadow of Prof Freud's serious illness, the ninth congress was very happily able to begin its business by sending Prof Freud a congratulatory telegram on his restoration to health

As at the last three congresses dating from 1920, the year which saw the first re-assembly since the pre-War period, many nations were represented and by many distinguished names In his presidential address Dr Karl Abraham, Director of the Berlin Psycho-Analytical Clinic, welcomed representatives who with relatives and visitors numbered about two hundred from Austria France, Germany Great Britain, Holland, Hungary India, Poland, Switzerland Russia, and the United States Dr Abraham expressed particular satisfaction at

the presence of his American colleagues, who included such well-known workers as Dr Jelliffe and Dr Pierce Clark of New York, Dr Trigant Burrow of Baltimore, and Dr Isidor Coriat of Boston. The attendance of representatives from France was another sign of the acceptance of Freud's views in countries which have hitherto stood aside.

The most important features to be noted in the movement are the developments of psycho-analytical theory and practice; the increase in the number of constituent societies, and in the membership of these societies; the continuous research work and the increased publication of results; the large amount of clinical work carried on, and the greater general attention given, even if at times in the form of opposition, to Freud's discoveries. The work of the Berlin and Vienna Polyclinics clearly evidences the need for, and appreciation of, psycho-analytic treatment, and it is much to be hoped that before long every country will establish similar clinics, especially so great and important a country as England, which is still, strange to say, without a solitary clinic for this treatment. The valuable help which can be obtained by those sufferers who have found no solution for their difficulties through existing methods of treatment will then be more widely appreciated.

The contributions to the Congress were divided into four sections: theoretical questions, therapeutical questions, clinical matters, and applied psycho-analysis—an arrangement which made for clearness and simplification. Perhaps the sections of the greatest interest, at least to the Congress as a whole, were the two dealing respectively with therapeutical questions and applied psycho-analysis. In the first section Prof. Freud's paper, a very technical one, on "The Bearing of the Anatomical Differences in Male and Female on the Oedipus Situation," was read by his daughter, Fraulein Anna Freud, who is herself a brilliant children's analyst, practising in Vienna.

Great interest was shown in the paper given by Dr Ferenczi (Budapest Psycho-Analytical Society), one of the most widely known Continental analysts, on "Counter-indications to Active Psycho-Analytic Technique," in which he dealt with the theme of "active therapy" once more. This subject, which was put forward by him at the Salzburg Congress and created a somewhat sensational effect as a seeming sharp departure from the Freudian technique in treatment, was now dealt with by Dr Ferenczi for the purpose of pointing out certain misconceptions which had arisen. It was important, he said, to realise that he did not suggest the employment of this "active" technique for all cases under treatment or as the sole method in any individual case, or with rigorous application, but only as *one* method at given times and at an appropriate stage. In respect to his "terminal limit" for the patient's treatment and the complete severance between patient and analyst when such a limit had been reached, a view also put before the Salzburg Congress, Dr Ferenczi explained that he no longer wished to adhere strictly to such practices, but rather to make use of them only in exceptional situations. It may be said that the general tenor of the paper was in the direction of more elasticity, more modification of previous stringent views, although without any abandonment of basic Freudian principles.

Much the same attitude was expressed in the paper given, in the same section, by Dr Otto Rank (Vienna Psycho-Analytical Society) on the birth theory formulated by him at the Salzburg Congress, and embodied in his book, "The Trauma of Birth." He made something of an apologia for his too definite pronouncement of a year ago, making it plain that he no longer regarded the birth-situation (the first great trauma) as the only significant one in the shaping of the individual's destiny, but as playing a vitally important role in the whole psychic drama. In this same section two more papers of interest were Dr Alexander's (Berlin Psycho-Analytical Society) on 'Neurose und Gesamtpersonlichkeit,' and Dr Pierce Clark's (New York Psycho-Analytical Society) on "The Phantasy Method of analysing Narcissistic Neuroses."

In the fourth section, dealing with applied psycho-analysis, a brilliant paper evidencing deep research, was read by Dr Geza Róheim (Budapest Psycho-Analytical Society), the well-known Hungarian anthropologist, who, it is interesting to recall, will read a paper before the Royal Anthropological Institute in London next month. Dr Róheim took for his subject 'The Scapegoat,' and expounded the origin and significance of the idea of the sin-offering and expurgation among ancient and primitive peoples. Dr Theodore Reik (Vienna Psycho-Analytical Society) gave a paper on "The Origin of Psychology," in which he dealt in a masterly manner with the problem of (to give a free translation of the German title) 'How do Human Beings come to bother about Psychology?'"

Dr M. D. Eder (British Psycho-Analytical Society) gave a paper on a hitherto little-investigated subject, "A Contribution to the Psychology of Snobbishness," claiming it as appropriate that this theme should be dealt with by a speaker from England, since that country was the classic home of snobbery. He worked out in a very interesting manner the sources and significance of snobbishness, illustrated from actual analytical cases and from the rich material in English literature, especially the work of Thackeray ("The Book of Snobs," "Pendennis"), of Meredith ("Evan Harrington"), and of Thomas Hardy ("A Pair of Blue Eyes").

At the business meeting which concluded the Congress, after re-electing to another term of office the president, Dr Karl Abraham, and the secretary, Dr Max Eitingon, to both of whom the Congress expressed sincere gratitude for their past work, an important decision was taken. This was to form an International Commission constituted from Committees formed in all the individual branch societies, to draw up regulations acceptable to all countries represented in the Association for the admission of practising analysts. For some time past it has been felt that the qualifications demanded from practising analysts differ too widely according to the country concerned and even the individual psycho-analytical society. In some cases the regulations are exceedingly strict, making for assured scientific equipment; in other cases, however, the qualifications demanded are too slight to ensure any genuine knowledge or experience on the part of the so-called analyst, or even that he has subjected himself to a real analysis. It is hoped that the new Commission will be able to frame regulations sufficiently acceptable to create uniformity of qualification, which shall be such as to ensure a high standard in respect of knowledge, training, and personal suitability for psycho-analytic practice.

The business proceedings ended with a debate on the meeting-place for the next Congress. The final choice lay between Italy and England, an invitation to the latter being extended by Dr Ernest Jones, president of the British Psycho-Analytical Society, and predecessor of Dr Abraham as president of the International Association. The question of distance

was of importance to the Continental members, and ultimately, by a very small majority, Italy was selected

In conclusion it is interesting to note that the characteristic feature of this Congress, one that sharply differentiated it from its predecessor, was the absence of dogmatic pronouncement and rigid conception, rather there was an apparent desire to discover how new, or partially new theories could be adjusted to already established facts, and a spirit of modification and adaptation on the part of those who earlier had put forward ideas of a somewhat disruptive nature This attitude, with the important decision already referred to in the direction of uniformity and increased efficiency in psycho-analytic practice, augurs hopefully for future developments in psycho-analysis, both in research and practical therapeutic work

The Royal Photographic Society's Exhibition

THE annual exhibition of the Royal Photographic Society at 35 Russell Square, London W C 1, remains open until October 24, and admission is free The scientific and technical sections are numerous, and each contains exhibits of notable interest The Astronomer-Royal shows "Prism-crossed Grating" spectra of Vega compared with spectra of the carbon arc and a ½-watt electric lamp The comparison of these spectra gives data from which the temperature of the star may be calculated from the known temperatures of the artificial illuminants Star spectra enlarged 7 6 times horizontally and broadened 19 5 times by means of a clepsydra apparatus invented by the exhibitor are contributed by Dr W J S Lockyer Among the aerial photographs are several fine examples by the Royal Aircraft Establishment, and the application of this method of work to archæological research is well illustrated by Messrs O G S Crawford and A Keiller, one of whose examples reveals an ancient village site seen through the crops, in Hampshire

The natural history section is a very large one, and those of the ordinary kind are only mentioned as a group because there is such a great variety of good work But Mr Oliver G Pike has endeavoured, with success, to show the action of the wings of birds during certain phases of flight Presumably these photographs are enlargements from his slow motion cinematograph films shown elsewhere Among the specimens of cinematograph films are some from the Eastman Kodak Research Laboratory which illustrate some possibilities in the use of colour and form in motion as a means of entertainment and to produce pleasurable sensations by an appeal to the visual sense similar to those produced by music The kodachrome two-colour subtractive process is used in the production of these films

The photomicrographs are many and chiefly low power work Dr G H Rodman illustrates the structure of the petiole of the water hyacinth, an aquatic floating plant of tropical America In another series of 24 sections he shows the character of the idioblasts which occur in various water lilies Mr F Martin Duncan contributes further studies on the cuticular scales of mammalian hairs, which confirm his theory of the importance of their specific characters in the phylogenetic study of mammals Photomicrographs of several alloys, chiefly alloys of copper, and illustrating flaws and changes produced by various treatments, are contributed by Capt J W Bampfylde Micro-radiography as applied to geology and palæontology is illustrated by 24 examples by Pierre Goby who also has four stereo-micro-radiographic pairs showing stereoscopic relief and pseudo-relief Of natural size radiographs there are many examples

Among the other examples of the application of photography to scientific investigations may be mentioned shutter test diagrams with full explanations from the optic division of the National Physical Laboratory, and Prof Coker s natural colour transparencies which show the nature of stress under various conditions in models of buildings The transmission of photographs over telephone wires for practically any distance and in a few minutes is illustrated by the International Western Electric Co, which shows transmitted photographic portraits, landscapes, views of buildings, letterpress, a finger-print, writing, charts, and a coloured photograph The perfection of the reproductions is remarkable Mr Thorne Baker has an example of a picture transmitted by wireless telegraphy The British Photographic Research Association shows the effect that fuming with ammonia has upon the character of the grain of silver bromide gelatine plates The selenium density meter designed by members of this Association is shown by Watson and Sons, and in the rather large trade section Chance Brothers show optical glass from its manufacture to the finished lens, and specimens which illustrate the effects of tests for durability of devitrification, and of the improvements in the quality of dense barium crowns in the years 1915 1917 1924, and this year In the last the colour is practically eliminated and bubbles are scarcely visible

Oyster Dredging in the Fal Estuary[1]

DR J H ORTON of the Marine Biological Association presents a useful report on the oyster fisheries of the Fal Estuary, which are managed by the Truro and Falmouth Corporations, being owned by the Duchy of Cornwall Each dredgerman takes out a licence and is entitled to dredge oysters more than 2½ inches in diameter during the winter months The proceeds formerly were largely used up in lawsuits, but we judge that they now mainly pay the wages of bailiffs, whose business it is to see that the size regulation is observed There would seem to be no cultivation of the oysters, no cleaning of the grounds, no laying of suitable hard material on which the spat can settle (cultch), nothing indeed beyond the relaying of already marketable oysters in private or leased intertidal waters until there are suitable market conditions

The spat falls in the three years 1922–24 were failures, and, as oysters are usually caught for market in their fourth and fifth years, the fishery is bound to be too lean for most of the 200-300 dredgermen to obtain a livelihood in 1926–29 even if the present year should see a good spat fall Dr Orton does not deal with the causes of the bad spat fall, and it is not clear whether there was an insufficiency of oyster larvæ or whether the ground was so muddy that they could not survive when they settled on the bottom

[1] Summary of a Report on a Survey of the Oyster Beds in the Fal Estuary in November 1924, with Notes on the Biology of the Oyster By Dr J H Orton (Published for the Falmouth and Truro Corporations)

We suspect the latter, as so much stress is laid on cultching as compared with the establishment of proper spawning stocks. Further, the small, mis-shapen, nut-like, rounded oysters, forming 45 per cent. of the stock, are characteristic of dirty ground.

The total stock on the grounds is estimated at about 8 millions, sufficient, if the "nuts" be deducted, to give a catch of upwards of a million a year, while in the last century the average catch was many times as much. Of course the raising of the catchable size and all sorts of restrictions in the fishing are suggested, but it is questionable if Dr. Orton's facts be accepted, whether these could do more than keep a limited number of dredgermen on the grounds while administrative authorities are seeing whether they will do anything.

Dr. Orton's summary does not tell us the exact condition of the Estuary to-day, but in 1915 the shores and main channel were filthy with mud, detritus, weed, etc., and the real question then seemed to us to be whether money could be found to harrow and cultch selected areas and afterwards to keep them in good order. A careful study of the alterations in land drainage, in mine workings, etc., of the watershed of the Estuary during the last century should show whether this is worth doing at all, and, if it be done, all regulations should be re-examined so that the fishermen should act as their own bailiffs for the new regulations, while their licence fees or royalties would be available for the upkeep of the whole grounds. We feel that it would be best for the two Corporations concerned either to return the fisheries to their owner, or to place themselves in the hands of Dr. Orton, or some other competent person, and carry out his behests.

J. S. G.

University and Educational Intelligence.

ST. ANDREWS.—Dr. David Rutherford Dow has been appointed to succeed Principal Mackay in the chair of anatomy in University College, Dundee. Since 1913 Prof. Dow has been lecturer in regional anatomy at the United College and assistant successively to Prof. Musgrove and Prof. Waterston, the Bute professors of anatomy there. His research work in anatomy has resulted in several papers published in the *British Medical Journal* and the *Journal of Anatomy*.

THE East Anglian Institute of Agriculture, Chelmsford, gives details in its Calendar for 1925–26 of some eighty courses which it offers in its departments of agriculture, agricultural biology, agricultural chemistry, dairy technology, horticulture, and poultry and small live stock. It undertakes to prepare students not only for its own certificates and diplomas and those of the Royal Agricultural and Royal Horticultural Societies and the British Dairy Farmers' Association, but also, in conjunction with University College, London, Bedford College for Women, East London College, and Chelsea Polytechnic, for the degrees in agriculture and horticulture of the University of London. The Institute specialises in animal husbandry, and farm economics, dominion agriculture, dairying, and commercial horticulture. It conducts a school gardening class on Saturdays for teachers. The North of Scotland College of Agriculture offers courses for the university degree in agriculture, the national diplomas in agriculture and dairying, a college diploma in poultry-keeping, and a special farmers' course in the winter. A joint committee of the College and the University of Aberdeen controls the Rowett Institute for Research in Animal Nutrition.

Societies and Academies.

WASHINGTON, D.C.

National Academy of Sciences (Proc. Vol. 11, No. 8, August).—Edwin B. **Wilson**: The logistic or auto-catalytic grid. Arithmetic and logarithmic probability paper on which the integrals of certain curves become straight lines, is of value in problems in chemistry, biology, economy and other subjects.—Nelson W. **Taylor** and Gilbert N. **Lewis**: The paramagnetism of 'odd molecules.' Evidence of paramagnetism was obtained for chlorine dioxide (in carbon tetrachloride), the free organic radicle α-naphthyl diphenylmethyl (in benzene) and in solutions of sodium in liquid ammonia and of thallium in mercury. In the latter solutions an electron is given up by the dissolved metal to the solvent, thus forming a molecule (the solvent) containing an unpaired electron.—Allan C. G. **Mitchell**: The activation of hydrogen by excited mercury atoms. The rate of reaction of mixtures of hydrogen and oxygen in the presence of mercury and exposed to light from a mercury lamp was measured and the effect of addition of argon determined. As the pressure of argon is increased, the reaction-rate decreases.—Selman A. **Waksman**: What is humus? 60–70 per cent. of the organic matter in the soil including the "humic acids" is soluble in alkalies and precipitated by acids. This portion can be divided into α- and β-fractions which are insoluble and soluble respectively in dilute acids. The α-fraction (or "humic acid") gives the soil its black colour and is derived from lignins and the cells of soil micro-organisms. The β-fraction provides the buffering properties to soils. Peat soils contain largely the α-fraction, while mineral soils contain the β-fraction in addition and often predominating.—R. L. **Moore**: Concerning the separation of point sets by curves.—Selman A. **Waksman**: The soil population. Soil organisms form a biological complex and should be studied as such.—Ludvig **Hektoen** and Kamil **Schulhof**: The precipitin reaction of thyroglobulin.—J. B. **Collip**: The internal secretion of the parathyroid glands. The secretion can be obtained in a stable form and in a degree of purity and potency hitherto not available. The method used is the dissolution of gland by controlled acid hydrolysis and isoelectric fractionation. The hormone obtained is specific for parathyroid tetany in dogs; its effect is related in the main to calcium metabolism and it causes mobilisation of calcium in the blood.—Samuel K. **Allison** and William **Duane**: An experimental determination of the critical excitation frequency for the production of fluorescent X-radiation. It would appear that to produce a fluorescent line spectrum the primary radiation must contain X-rays of frequency at least as great as that of the corresponding critical absorption.—William **Duane**: The calculation of the X-ray diffracting power at points in a crystal. To calculate the density of the diffracting power (or density of electron distribution) from the measured intensities of diffracted beams, certain fundamental assumptions relating to the symmetry of the crystal must be made.—Carl **Barus**: The effect of commutation of impedances on the acoustic pressure produced by paired telephonic systems.—R. T. **Cox** and J. C. **Hubbard**: A statistical quantum theory of regular reflection and refraction. Large aggregates of quanta are dealt with, and it is assumed that the media traversed by these quanta are continuous, that the quanta travel with the velocity of light and suffer a change of velocity but not of energy on passing from one medium to another.—R. J. **Havighurst**: (1) The distribution of diffracting power in sodium

chloride The density of electron distribution indicates that along the cube edge and body diagonal there is an alternation of two kinds of atoms, along the face diagonal, all are alike (2) The distribution of diffracting power in certain crystals Potassium and ammonium iodide have the sodium chloride structure, ammonium chloride has the body-centred cæsium chloride structure The "electron density" of diamond cannot yet be determined —A Keith **Brewer** Ionisation produced in gaseous reactions Ethyl alcohol and oxygen are allowed to react, at temperatures below that of ignition, between gold, aluminium, copper, and glass electrodes It is concluded that ions are formed in the gas layer in immediate contact with the electrode and that positive and negative ions are formed in equal numbers —G F **Rouse** and G W **Giddings** Ionisation of mercury vapour by ultra-violet light When mercury vapour between two plane parallel electrodes is illuminated by light from a hot mercury arc, the ratio of the currents to the two electrodes is approximately that of the areas of the electrodes, indicating photo-electric action With a water-cooled mercury arc and increased mercury vapour pressure, the currents observed are much greater and their ratio practically unity, indicating true ionisation No single wave-length of sufficient energy to do this appears to be present, so a cumulative action must occur —O K **De Foe** and G E M **Jauncey** Modified and unmodified scattering coefficients of X-rays in matter Taking into consideration Compton's change of wave-length with scattering, the ratio of the scattering coefficient of the modified to the unmodified rays is calculated Experimental results using copper are in fair accord with the calculation —G E M **Jauncey** and O K **De Foe** The energy reappearing as characteristic X-rays when X-rays are absorbed in copper The methods developed in the previous paper are used, and it is found that the greater part of the energy absorbed goes into the photo-electric ejection of K-electrons

SYDNEY

Royal Society of New South Wales, August 5 —G **Taylor**, W R **Browne**, and F **Jardine** The Kosciusko Plateau, a topographic reconnaissance The area investigated extends from "The Creel" at 3000 feet elevation in the east, to Kosciusko (7300 feet) in the west, a distance of 20 miles As a result approximate contours (form-lines) of 100 feet interval were obtained, and these have been drafted on a map to the scale of half-mile to the inch Aneroid and Abney-level observations were relied upon for heights These were supplemented by sketches and photographs which were carefully orientated and annotated —A R **Penfold** and J L **Simonsen** The essential oils from the leaves of *Murraya Koenigii* (Spreng), *Murraya exotica* (Linn), and *Murraya exotica*, var *ovatifoliolata* (Englor) —J H **Maiden** and W F **Blakely** Descriptions of sixteen new species of Eucalyptus Six are eastern species (including one from South Australia) and ten from Western Australia Two are suggested hybrids, while one has already been described as a variety Of the eastern species, three are from Queensland, a pale-wooded bloodwood, a northern box and a glaucous ironbark, also from the north Of the two suggested hybrids the South Australian one comes nearest to *viminalis*, while one from the Federal Territory is a rough-barked species nearest to *maculosa* The western species include five mallees, and two fairly large trees, the "Stocking tree" of Kondinin, so called because of its rough bark, sharply defined from a smooth trunk, and the Albany blackbutt, raised to specific rank

Official Publications Received

Department of the Interior United States Geological Survey Bulletin 757 Geology and Coal Resources of the Axial and Monument Butte Quadrangles, Moffat County, Colorado By E T Hancock Pp vi+134+6 plates 35 cents Bulletin 772 A Reconnaissance of the Point Barrow Region, Alaska By Sidney Paige, W T Foran and James Gilluly Pp v+32+9 plates 20 cents (Washington Government Printing Office)

The Royal Technical College, Glasgow Calendar for the One Hundred and Thirtieth Session, 1925–1926 Pp xxix+403 (Glasgow)

The Stratigraphy of the Mississippian Formations of Iowa By Francis M Van Tuyl (From Iowa Geological Survey, Vol 30, Annual Reports 1921 and 1922) Pp 33 374+6 plates (Des Moines Iowa Geological Survey)

Transactions of the Royal Society of Edinburgh Vol 53, Part 3, No 33 Perthshire Tectonics Loch Tummel, Blair Atholl and Glen Shee By E B Bailey Pp 671 698+1 map (Edinburgh R Grant and Son, London Williams and Norgate, Ltd) 4s

Proceedings of the Royal Society of Edinburgh, Session 1924–1925 Vol 45, Part 3 No 23 On the Cardinal Function of Interpolation Theory By W L Ferrar Pp 269 282 1s 6d Vol 45, Part 3, No 24 The Electrosynthesis of *n* Duotriacontane Dicarboxylic Acid By Dr David A Fairweather Pp 283 285 6d (Edinburgh R Grant and Son, London Williams and Norgate, Ltd)

Diary of Societies

SUNDAY, SEPTEMBER 27

ASSOCIATION OF SPECIAL LIBRARIES AND INFORMATION BUREAUX (Conference at Balliol College, Oxford), at 9 30 A M —B N Langdon Davies The Publisher and Research Libraries —At 8 30 P M —H E Potts Patents and Special Libraries —H J Jeffery The Imperial Institute its Work and the Methods adopted in the Library to meet its Special Needs —Miss A L Lawrence, A J Mundella, Percy Alden A Sociological Library —Miss Clayton, Brig Gen Sir Magnus Mowat, Major W E Simnett Transport Intelligence and Publicity —Sinclair Wood Research as the Basis of Advertising

TUESDAY, SEPTEMBER 29

ROYAL PHOTOGRAPHIC SOCIETY, at 7 —Sir Nevile Wilkinson Decoration in Heraldry

THURSDAY, OCTOBER 1

FARADAY SOCIETY (at Oxford) —Discussion Photochemical Reactions in Liquids and Gases —At 3 30–5 and 5 30–7 30 —Part I Einstein's Law of Photochemical Equivalence —Prof A J Allmand Introductory Paper —Prof F Weigert and Dr L Brodman The Verification of the Einstein Photochemical Equivalent Law in a very Simple Photo sensitive Liquid System —Prof Chr Winther The Relation between Quantum Sensitivity and Intensity of Radiation —Prof J Rice Note on the Radiation Theory of Chemical Reactions —Prof L S Ornstein Note on the Influence of Radiation on Chemical Reactions —Prof D Berthelot The Law of Photochemical Equivalents and the Place of the Quantum Theory in Relation to Atomic Theory and Energetics —Prof P Lasareff Relations between the Velocity of Photochemical Reactions and Wave Length —Prof O Stern On the Transformation of Atoms in Radiation —General Discussion

CHILD STUDY SOCIETY, at 6 —William Platt The Child's Innate Feeling for Music

FRIDAY OCTOBER 2

FARADAY SOCIETY (at Oxford) —Discussion Photochemical Reactions in Liquids and Gases —At 10–1 and 2 30–5 —Part II On the Mechanism of Photochemical Reactions —Prof M Bodenstein Introductory Paper —Prof J Franck Elementary Processes of Photochemical Reactions in Gases —D L Chapman Some Conclusions from Recent Work on Photochemistry —Prof H S Taylor Photosensitisation and the Mechanism of Chemical Reactions —E J Bowen The Dissociation Theory and Photochemical Thresholds —Prof Chr Winther Dielectric Constant and the Speed of Photochemical Reactions —R O Griffith and A McKeown The Photochemical and Thermal Decomposition of Ozone —Dr E B Ludlam and W West The Electron Affinity of the Halogens —W Taylor The Physical Antecedents of the Photo activity of Chlorine —Prof W Albert Noyes, Jr The Formation of Polar Compounds by Photochemical Reactions —Prof von Halban Absorption of Light in Solutions of Electrolytes —Dr H Kautsky On Chemiluminescence —Prof C Berthoud Photochemical Sensitisation —Miss C E Bluler Flame Spectra and Chemical Reaction —W J van Dijck The Becquerel Effect on Copper Oxide Electrodes —Prof J Perrin The Photochemistry of Fluorescent Solutions —Prof E Bauer The Photolysis of Methylene Blue Sensitised by Zinc Oxide —Prof A Coehn The Influence of Moisture on Photochemical Reactions in Gases —Prof I Plotnikow (1) Concerning the Fundamental Laws of Photochemistry (2) Photochemical Reactions and Methods of Measuring them —Prof N R Dhar and B K Mukerji (1) Einstein's Law of Photochemical Equivalence, (2) The Mechanism of Photo chemical Reactions

ROYAL PHOTOGRAPHIC SOCIETY, at 7

JUNIOR INSTITUTION OF ENGINEERS —H Bishop Problems of Broad casting

SMOKE ABATEMENT LEAGUE OF GREAT BRITAIN (at Buxton) —Conference on Smoke Abatement

SATURDAY, OCTOBER 3

SMOKE ABATEMENT LEAGUE OF GREAT BRITAIN (at Buxton) —Conference on Smoke Abatement

SUNDAY, OCTOBER 4

SMOKE ABATEMENT LEAGUE OF GREAT BRITAIN (at Buxton) —Conference on Smoke Abatement